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## Opportunity or Threat? Exploring Middle Manager Roles in the Face of Digital Transformation

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**ABSTRACT** With the proliferation of automation technology, controversy concerning the impact of digital automation on middle-managers' strategic importance is rising. Some scholars adopt an '*automation-as-a-threat*' view to argue that digital automation replaces middle-managers' strategic value. On the contrary, others take an '*automation-as-an-opportunity*' view to underscore the role accumulation advantages digital automation offers for individuals in organizations. We acknowledge this debate and develop a contingency-based role-theoretical framework, suggesting that the impact of automation on middle-managers' strategic involvement depends on: (a) the nature of the middle-management tasks subject to automation, and (b) the level of the individual middle-manager's task-related expertise and simultaneous role embeddedness – as defined by their position tenure. We test our framework using longitudinal survey data from German, Swiss and Austrian firms at four time points. Overall, our work takes an important step toward unravelling the complex and contingent impact of digital automation on middle-managers' strategic involvement in contemporary organizations.

**Keywords:** automation, digital transformation, middle managers, role theory, strategy involvement

### INTRODUCTION

Vivid terms such as 'the digital future' (Kane et al., 2016), 'the fourth industrial revolution' (Schwab and Davis, 2018), and 'digital disruption' (Posner, 2018) describe the challenges facing contemporary organizations, as well as individuals today with regard

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to the proliferation of automation technology (von Krogh, 2018). A central stream in this broad area of inquiry examines how digital automation impacts individuals at different managerial levels of the organizational hierarchy (Acemoglu and Restrepo, 2018a; Pinsonneault and Kraemer, 1993), as well as their likelihood to make an active contribution to the organization's strategic direction, i.e., strategy involvement (Cadez and Guilding, 2008; Lindebaum et al., 2020). The question of how automation technology affects managerial roles in contemporary organizations becomes particularly relevant when considering the different nature of automation systems today compared to some years before (Krzywdzinski, 2021; Pinsonneault and Kraemer, 1993; Raisch and Krakowski, 2021). Studies, for example, have shown that modern automation technology has evolved in terms of both pace and scope over the last decades (Krzywdzinski, 2021). As such, the evolving nature of automation technology warrants reconsideration of basic terms about how automation efforts impact the various roles of individuals at different managerial ranks (Firk et al., 2021).

The middle management context is especially interesting when it comes to this area of inquiry (Loebbecke and Picot, 2015; Millman and Hartwick, 1987; Pinsonneault and Kraemer, 1993). Scholarly work (Singh and Hess, 2017) and public press (Stubbings et al., 2019) recognize that the middle-rank will be affected disproportionately by how digital technology envelops or augments its strategic imperative (Raisch and Krakowski, 2021). Focusing on the impact of automation on how middle managers influence organizational strategy then emerges as a key focus of inquiry. This is because traditionally, middle managers act at the interface between top tier managerial ranks and other hierarchical levels (Ou et al., 2017), and thus, can inform organizational strategy via top-down and bottom-up means of influence (Heyden et al., 2017; Reimer et al., 2016a). Addressing the contingencies through which digital technology impacts the strategic importance of middle managers therefore holds promise, in that it allows us appreciate whether and how the strategic impact of middle managers, as widely acknowledged today (Mantere, 2008), is expected to alter in the era of the fourth industrial revolution.

In this regard, extant research provides divergent insights as to whether digital automation promotes or prevents middle managers from adopting more active roles in strategy formation. Some scholars have used an '*automation-as-a-threat*' perspective to underscore the risks that digital automation poses for middle-rank managerial labour (Benedikt and Osborne, 2017). As digital technology penetrates the world's economy, individuals at the middle rank face the risk that a large part of their everyday tasks and routines will be altered, or even replaced, by automated systems (Acemoglu and Restrepo, 2019, 2020; Brynjolfsson and McAfee, 2014). Yet, another stream of research has adopted an '*automation as an opportunity*' perspective (Autor, 2015) to highlight that automated systems can generate role accumulation opportunities (von Krogh, 2018), enabling middle managers to engage more actively in the strategy processes (Bloom et al., 2014; Raisch and Krakowski, 2021). These divergent insights have led to calls for adopting contingency approaches to unravel why the field offers these contradictory perspectives (Acemoglu and Restrepo, 2019).

Drawing on role theory in strategic leadership research (Biddle, 1986; Georgakakis et al., 2022; Raes et al., 2011), and the literature of work-role transitions (Ibarra and Barbulescu, 2010; Nicholson, 1984), we argue that when tasks are automated, middle

managers' strategic influence is likely to be affected by: (a) the nature of middle management tasks subject to automation, and (b) the individual middle manager's role expertise and simultaneous role embeddedness in traditional role assumptions. Recent advancements in the literature of automated systems have defined two distinct task categories – i.e., *formal-rational* and *substantive-rational* tasks (Lindebaum et al., 2020; Wijethilake et al., 2018). On the one hand, formal-rational tasks are more rule-based and repetitive in nature – and their focus centres on the gathering and structuring of non-complex and explicit information (Knight, 2017). Due to their explicit-knowledge and routine-based nature of collecting and sharing basic information, these tasks are presented as easier to automate and can be captured by automation technology by more wholly replacing the role of the human actor (Lindebaum et al., 2020). On the contrary, substantive-rational tasks are more future-oriented, infused with non-explicit information, and affected by factors beyond organizational boundaries (Føllesdal, 1994). These tasks are more challenging to automate, as they involve a decision component and generally demand human monitoring and intervention for their effective functioning post-automation (Lindebaum et al., 2020). Given their distinct nature, we postulate that the automation of formal- and substantive-rational tasks will have differential effects on middle manager strategy involvement.

Further, our theoretical framework embraces the reality that the effects of formal-rational and substantive-rational task automation on middle management strategic involvement is not unitary for all middle managers, but rather varies with their individual-level characteristics (Heyden et al., 2017). Whereas prior research has long examined the economic and institutional determinants that drive the effects of automation on middle managers' strategic involvement (see e.g., Bloom et al., 2014; Pinsonneault and Kraemer, 1993), factors at the individual middle management level remain relatively unexplored. This omission is important, since the effects of corporate modernization on role transitions largely depend on individuals' embeddedness in traditional roles (Ibarra and Barbulescu, 2010; Nicholson, 1984), as well as their accrued expertise in performing these roles (Biddle, 1986; Dane, 2010; Georgakakis et al., 2022; Raes et al., 2011). Building on this premise, we consider the position tenure of middle managers as a key individual-level contingency. It affects how role transitions occur in the face of automation – given that position tenure associates with individual embeddedness in traditional roles and routines (Hambrick and Fukutomi, 1991; Sengupta et al., 2008), as well as the expertise gained from past role-specific experience (Dane, 2010).

Our study offers several contributions. It takes a step to reconcile the seemingly contradictory arguments in extant literature with regards to how digital automation impacts middle managers' strategic importance. It stresses that a key aspect for unravelling this controversy is to pay attention to the nature of the task that becomes automated, as well as the individual level attributes of the middle manager. In line with our expectations, automation of 'formal-rational' tasks (i.e., explicit-knowledge based tasks related to abstract and formal procedures, rules, and laws (Lindebaum et al., 2020, p. 248)) and 'substantive-rational' tasks (i.e., tasks that include tacit-knowledge that require recognition or discovery of the multidimensional structure, shape and significance of future-oriented action) (Lindebaum et al., 2020), differentially affects middle managers' involvement in strategy

formation – while wholly contingent on individual middle manager position tenure. We recognize the automated system as a key non-human actor that actively influences how tasks are carried out and how this impacts the strategic role of the individual middle manager (Acemoglu and Restrepo, 2018b; Bryant and Stensaker, 2011; Carter and Fuller, 2016). Our work substantiates the ideas of role accumulation (i.e., when additional and potentially more complex roles are realized and adopted) (Mantere, 2008; Nicholson, 1984; Raisch and Krakowski, 2021) and role transitions (when roles are subject to adaptation due to changes in the social system) (Floyd and Lane, 2000; Ibarra and Barbulescu, 2010; Nicholson, 1984) in human-system interactions in middle management research.

Our work also acknowledges the trade-off between expertise benefits and role embeddedness challenges of position tenure (Dane, 2010). By drawing on the literature of work-role transitions (Ibarra and Barbulescu, 2010; Nicholson, 1984), it stresses that the time spent in the middle management position differentially impacts the effects of formal-rational versus substantive-rational task automation on middle managers' strategy involvement. Due to the different explicit- versus tacit-knowledge nature of these tasks (Lindebaum et al., 2020), as well as their differential exposure to a human-system interface after transformation (Raisch and Krakowski, 2021), their automation will give different weight to the role-embeddedness costs and expertise benefits of long-tenured middle managers – thereby having a differential impact on their strategy involvement. To this end, our work shows that not all individual members of the middle rank are likely to be affected by automation technology in the same way. Instead, it implies that a deeper focus on the individual-level middle manager traits, in parallel with the nature of the tasks that become automated, is required to unravel whether and how automation impacts the middle-rank's strategic importance.

## THEORETICAL FRAMEWORK

Extant research has emphasized the role of middle managers in informing organizational strategy (Balogun and Johnson, 2004; Wooldridge and Floyd, 1990). As Heyden et al. (2017, p. 963) commented, the bottom-up influence of middle managers 'is often captured in what has become known as the Middle Management Perspective (Wooldridge et al., 2008), which advocates and documents the pivotal roles of [middle managers] in driving change from the organization's core (Balogun and Johnson, 2004; Huy, 2002; Wooldridge and Floyd, 1990)'. From this point of view, middle managers' involvement in strategy has key implications not only for the business unit in which they are embedded, but also for the overall strategic organization and its functioning (Van Doorn et al., 2015).

Rising attention for the strategic impact of middle managers has coincided with the adoption of automated systems and the substantial layering of organizations. Studies acknowledge that middle management roles are flexible and dependent on the interactions among organizational actors (Mantere, 2008; Rouleau and Balogun, 2011), as well as non-human and system-specific agents (such as modernized automated systems) (Acemoglu and Restrepo, 2018b; Millman and Hartwick, 1987; Pinsonneault and

Kraemer, 1993). Yet, how middle-management roles in the co-production of organizational strategy evolve when different aspects in their task context become automated has not yet been clearly established in the literature (Bloom et al., 2014; Heyden et al., 2017).

Extant research has categorized managerial tasks based on their nature into ‘formal-rational’ and ‘substantive-rational’ (Allen, 2004; Broadbent and Laughlin, 2009; Delmestri and Walgenbach, 2005; Kondrat, 1992; Mangaliso, 1995). According to Kondrat (1992, p. 242), formal-rational tasks are mainly associated with rule-based, repetitive actions – and are solely bounded within the organization’s internal facts (see also: Allen, 2004; Delmestri and Walgenbach, 2005). Such tasks are generally based on explicit knowledge as they rely on facts and rules that are easily transmittable (Lindebaum et al., 2020). On the contrary, substantive-rational tasks involve ‘an emerging recognition or discovery of the multidimensional structure, shape and significance’ of a complex and puzzled issue at hand – such as future-oriented decisions (Kondrat, 1992, p. 242). Such tasks involve both explicit- and tacit-knowledge components, are more challenging to automate due to the multifaceted decision environment, and when automated they often require continued human-system interaction which may impose time inefficiencies and build role ambiguity (Lindebaum et al., 2020).

Role theory attains to explain how managerial roles evolve when a role-transition is imposed by changes that occur in the social system, where automation is a distinct part of that system (Ashforth and Saks, 1995; Fondas and Stewart, 1994; Raes et al., 2011). In conceptualizing the impact of automation on middle management roles (Currie and Procter, 2005), we thus distinguish between the automation of ‘formal-’ versus ‘substantive-’ rational middle management tasks (Lindebaum et al., 2020; Wijethilake et al., 2018). In capturing middle management tasks, we focus on a specific middle manager, i.e., the head of the controlling unit and emphasize their roles in ‘reporting’ and ‘budgeting’ – as those have been evidenced to require substantial input from the head of controlling (Brink et al., 2018; Chong and Wang, 2019).

The reason we focus on middle managers at the head of the controlling unit is twofold. First, the controller role has been evidenced as one of the organizational functions at the front line of automation processes (Richins et al., 2017). Studies have shown that middle managers in the accounting and controlling unit are substantially affected by the proliferation of automation technology – due to the centrality of the accounting function for the organization and its future strategic orientation (Bhimani and Willcocks, 2014; Warren Jr et al., 2015). Second, research has evidenced that controllers’ task contexts balance both formal- and substantive-rational tasks (Weber, 2011). This provides an appropriate setting for examining the differential impact of formal- versus substantive-rational task automation on middle managers’ strategic involvement.

From the outset, a reporting-task for head of controlling middle managers is considered as formal-rational in nature, as it directly associates with the gathering, screening, and editing of pre-defined explicit information (Gupta and Thomson, 2006). Since reporting is frequently repeated and rule-based, it primarily requires middle managers to consider explicit knowledge and engage in formal-rationality for performing the routine reporting task (Wijethilake et al., 2018). Due to its routine and explicit knowledge nature, these tasks are easier to automate, and the system can more autonomously perform the reporting role without necessarily requiring the human actor’s

intervention (Lindebaum et al., 2020; Raisch and Krakowski, 2021; Wijethilake et al., 2018). Conversely, the automation of tasks associated with substantive-rationality, such as budgeting, aims to account for non-explicit future-oriented aspects and often require to be paralleled by human monitoring and intervention to function effectively (Cadez and Guilding, 2008; Clinton and White, 2012; Endsley and Kiris, 1995; Raisch and Krakowski, 2021).

Beyond the nature of the task context, we also highlight an important individual level contingency under which middle management role expectations are likely to fluctuate with the automation of formal-rational (reporting) versus substantive-rational (budgeting) tasks – i.e., position tenure. Studies have shown that position tenure associates with both expertise benefits and role embeddedness costs (Dane, 2010; Sengupta et al., 2008). The expertise benefits occur from the depth of knowledge an individual acquires in performing a given role (Dane, 2010). At the same time, the ability and flexibility in adjusting to modernized role assumptions vary based on the time that individuals have been embedded in traditional role assumptions (Biddle, 1986; Sengupta et al., 2008). Acknowledging that position tenure associates with both expertise benefits and role embeddedness costs for long-tenured middle managers, we suggest that it will act as a key factor that differentially affects the impact of formal-rational versus substantive-rational task automation on middle managers' strategic involvement. Below, we elaborate on our theoretical logic and develop our hypotheses.

## HYPOTHESES

### **Formal-Rational Task Automation (i.e., Reporting) and Middle Managers' Strategy Involvement**

Reporting is a rule-based and repetitive function that requires middle managers to manually gather, check and edit information on organizational processes for subsequent sharing with a range of actors in the organization (Moeller et al., 2020). This task is primarily formal-rational in nature in that it deals largely with explicit information that is straightforward (albeit time consuming) to manually obtain, standardize and disseminate (Moeller et al., 2020). Formal-rational tasks have been characterized as functions that can be captured by automated systems in a straightforward manner, given that they largely deal with explicit informational inputs (Lindebaum et al., 2020; Raisch and Krakowski, 2021). Reporting automation, then, refers to the adoption of an automated system that primarily aggregates data, prepares standardized reports (Gupta and Thomson, 2006), and due to the relative ease of capturing explicit-information with the automated system (Lindebaum et al., 2020), it largely replaces human actors' engagement with such routine-based functions post-automation (Kanellou and Spathis, 2013; Raisch and Krakowski, 2021). This often associates with efficiency gains for middle managers, such as alleviating time constraints in preparing standardized reports (Kanellou and Spathis, 2013).

While the automation-for-efficiency argument is clear (Cooper et al., 2019), we should consider the impact of formal-rational task automation (reporting) on the social system (Mantere, 2008) to understand its role theoretical implications for the strategic

importance of middle manager. From a role theory viewpoint, increasing reporting automation is expected to alter the dependencies that middle managers face in their role-specific task context – as it largely replaces a significant part of their everyday routine and role-enactment process (Kremser and Blagoev, 2021). That is, when formal-rational tasks become automated (Lindebaum et al., 2020), the system is expected to largely replace the human's role in gathering, coding, and sharing explicit information, requiring little subsequent human-system interaction (Raisch and Krakowski, 2021). This may result in role-depletion (i.e., when certain human roles are substantially reduced), requiring middle managers to actively explore higher level activities so that to retain and enhance their strategic relevance in the organization. Reporting automation then, is *ceteris paribus* expected to release middle managers from engaging with a time-consuming formal-rational task and connect with role accumulation opportunities for strategy involvement (Kanellou and Spathis, 2013).

Indeed, this argument is in line with recent work that outlines how automation may relate to the 'accumulation' of human roles (Raisch and Krakowski, 2021) when it promotes, either through active cues or by offering time efficiencies (von Krogh, 2018), opportunities to explore new and more strategic role activities beyond those performed by the automated system (Acemoglu and Restrepo, 2020). While the realization of such benefits is clearly expected to vary among individual middle managers – depending on how embedded they are with formal-rational task functions, and thus how easily they can transit to the new role-specific context (Ashforth and Saks, 1995; Ibarra and Barbulescu, 2010; Nicholson, 1984) – formal-rational task automation is *ceteris-paribus* expected to have a positive impact on middle managers' strategy involvement. This claim corroborates recent literature stressing that when routine-based (formal-rational) tasks are automated, humans may shift their attention to more strategy-related aspects in an effort to differentiate themselves and enhance their strategic importance in the social system (Brynjolfsson and McAfee, 2014; von Krogh, 2018).

*Hypothesis 1:* Formal-rational (i.e., reporting) task automation has a positive impact on middle manager strategy involvement.

### **Substantive-Rational Task Automation (i.e., Budgeting) and Middle Managers' Strategic Involvement**

In contrast with reporting, the budgeting task is future-oriented, involves a decision component, and presents a multifaceted puzzle geared at aligning managers' aspirations with corporate and market realities (Bhimani et al., 2018). This task is substantive-rational in nature, as next to explicit-knowledge, it also demands attention for tacit-knowledge cues of broader bandwidth – where the rules and models for budgeting need to account for the uncertainty and forward-looking nature of the task (Lindebaum et al., 2020). The automation of substantive-rational tasks, such as budgeting, demands substantially more human-system interaction in its aftermath compared to formal-rational (reporting) task automation (Raisch and Krakowski, 2021; Wijethilake et al., 2018). Given the uncertainty involved in the decision-related and future-oriented nature of substantive-rational tasks, it is challenging – and often

also risky and problematic – to fully replace this function with an automated system without parallel human-expert supervision and interpretation (Lindebaum et al., 2020; Wijethilake et al., 2018). Considering the complex nature of the budgeting function where explicit *and* tacit cues co-inform the information environment (Cooper et al., 2019), paired with the obstacles to fully replace substantive-rational tasks by automation technology (Lindebaum et al., 2020), we argue that budgeting automation may carry time inefficiencies and build role-ambiguity (i.e., when specifications for an expected role are incomplete or insufficient (Currie and Procter, 2005)) as middle managers make sense of human-system interface requirements post-automation. This, in turn, prevents middle managers from exploring more detached role accumulation processes and enhance their strategic role in the organization.

We again consider our argument on budgeting automation along expected role alternations in the social system (Mantere, 2008). Given that the pre-arranged scope of the automated system is unlikely to comprehensively account for all interconnected details that together inform complex budgeting functions – the middle manager is expected to attend to and fill potential gaps in the system's approach (Lindebaum et al., 2020; Wijethilake et al., 2018). However, recognition of system gaps and their swift resolve without the usual manual context on how issues emerge and should be dealt with, may accentuate time inefficiencies and role ambiguity between the middle managers and the automated system. For instance it may be difficult to understand which aspects need ongoing inputs from the human actor (i.e., from the middle manager) and which specific human inputs are required (Floyd and Lane, 2000; Rangarajan et al., 2005). The resulting role-ambiguous interface may spur preoccupation with the management of deficiencies, confusing role expectations, and thus offsetting attention for deeper deliberations on how budgeting decisions may inform strategy formation. Together, these aspects are – *ceteris paribus* – expected to make the middle manager more concerned with accommodating the human-system interface as substantive-rational tasks are automated, and thus, less focused on role accumulation processes that present potential to adopt more strategic roles.

Indeed, our arguments are in line with prior studies that outline how substantive-rational tasks may be more challenging to be wholly captured by automated systems (Lindebaum et al., 2020; Raisch and Krakowski, 2021) – and may therefore cause more role-ambiguity at the human-system interface after automation that prevents middle managers from placing attention on accumulating more strategic roles post-automation. The added complexity and difficulty in automating substantive-rational tasks (Lindebaum et al., 2020) is also expected to often make system outcomes more reliant on time consuming and potentially inefficient human-system interfacing processes (Raisch and Krakowski, 2021). In line with the above, we argue that automation of the budgeting function may place the middle manager at a greater distance from opportunities to inform organizational strategy.

*Hypothesis 2:* Substantive-rational (i.e., budgeting) task automation has a negative impact on middle manager strategy involvement.

### **The Contingent Role of Position Tenure**

Thus far, we have theorized that the effects of automation on middle managers' strategic involvement vary with the nature of the task that becomes automated. Yet, these

effects at the task-level are unlikely to be unitary for all individuals in a firm's middle rank. Instead, they are expected to vary with the middle manager's attributes and background (Heyden et al., 2017). Bridging our role theory argumentation with insights from the concept of work-role transitions (Ashforth and Saks, 1995; Ibarra and Barbulescu, 2010; Nicholson, 1984) and the literature on managerial tenure (Hamori and Koyuncu, 2015; Sengupta et al., 2008), we highlight position tenure as a key individual-level attribute that is expected to differentially impact the effects of formal-rational and substantive-rational task automation on middle managers' strategy involvement.

Compared to organizational tenure (firm-specific experience) and industry tenure (industry-specific experience) (Mueller et al., 2021), position tenure relates to the time an individual has worked in a given post (Ng and Feldman, 2013), and presents the following trade-off: the more time an individual spends in a given position, the greater the expertise they acquire in performing the specific role – and at the same time, the more they become embedded to the practices, processes, and role expectations of the task context (i.e., role embeddedness) (Dane, 2010; Hamori and Koyuncu, 2015; Hanelt et al., 2021; Sengupta et al., 2008). In work-role transitions (i.e., when an alternation happens in the role-specific context of the social system), individuals are likely to benefit from their expertise when some components of the previous role-specific context are retained after the alternation (Ashforth and Saks, 1995; Ibarra and Barbulescu, 2010; Karaevli and Hall, 2006; Nicholson, 1984). When the previous role, however, is becoming wholly and abruptly obsolete after alternation (i.e., by the automated system), embeddedness in prior role assumptions and processes (i.e., due to long position tenure) is likely to outweigh expertise benefits – generating cognitive displacement for the individual who is required to swiftly disengage from deeply-learned role-specific practices (Ashforth and Saks, 1995). Cognitive displacement (i.e., the unconscious defence of prior well-learned rationales in work role transitions (Ashforth and Saks, 1995; Ibarra and Barbulescu, 2010; Kremser and Blagoev, 2021; Nicholson, 1984)) would prevent middle managers from focusing on the realization of role-accumulation opportunities.

Since formal-rational task automation is more prone to largely replace the human role by the automated system compared to substantive-rational task automation that demands more human-system interaction in its aftermath (Lindebaum et al., 2020; Raisch and Krakowski, 2021), we postulate that position tenure will differentially impact the effects of these two types of task-automation on middle managers' strategy involvement. Below, we discuss comprehensively how the effects of long (versus short) position tenure unfold as middle managers acclimatize to increased formal-rational and substantive-rational task automation.

### **Position Tenure and the Automation of Formal-Rational Tasks**

While we anticipate formal-rational task automation to provide opportunities for middle managers to engage in strategy formation through role accumulation processes, some middle managers may benefit from such processes more than others. Indeed, the fact that individuals are likely to be differentially affected by alternations

in their task context is highlighted by the notion of ‘work-role transitions’ (Ashforth and Saks, 1995; Ibarra and Barbulescu, 2010; Nicholson, 1984). This notion implies that, after a radical change in the task-specific context, some managers may need more effort than others to transit to a new role-specific environment and realize role-accumulation opportunities – depending on how embedded they are in past practices, and how these practices become ‘obsolete’ versus ‘partially-retained’ in the alternation’s aftermath (Hambrick and Fukutomi, 1991; Ibarra and Barbulescu, 2010; Nicholson, 1984).

Building on the *expertise* versus *role-embeddedness trade-off* facing longer- versus shorter-tenured middle managers (Dane, 2010; Sengupta et al., 2008), and the notion of work-role transitions (Ashforth and Saks, 1995; Nicholson, 1984), we postulate that the positive impact of formal-rational task automation on middle managers’ strategy involvement will be less pronounced for longer-tenured middle managers. That is, while long-tenured middle managers will have acquired more expertise in the handling of formal-rational tasks’ explicit information, they will have to largely disengage from and unlearn past practices in which they are embedded to benefit from emerging role accumulation opportunities (Ashforth and Saks, 1995; Lindebaum et al., 2020; Raisch and Krakowski, 2021). As formal-rational tasks can be more easily and wholly replaced by automation technology without demanding human-system interaction post-automation, this radical role transition is expected to cause more cognitive displacement to long-tenured middle managers who are more embedded in the pre-automation formal-rational (reporting) role (Sieber, 1974) – and thus require more effort to become detached from previously learned practices in favour of new role accumulation opportunities (Ashforth and Saks, 1995; Lindebaum et al., 2020; Nicholson, 1984; Raisch and Krakowski, 2021).

Indeed, studies have shown that embeddedness in past practices builds up along extended position tenure (Hambrick and Fukutomi, 1991). When the reporting task is largely replaced by automation, and does not demand future human-system interaction to role enactment (Lindebaum et al., 2020; Raisch and Krakowski, 2021), cognitive displacement from the radical role transition may occur (Ashforth and Saks, 1995; Nicholson, 1984). This then demands more effort from long-tenured, and relatively more embedded, middle managers to adapt to the new system and realize the opportunities it presents (Ashforth and Saks, 1995; Hanelt et al., 2021; Nicholson, 1984). Put differently, since formal-rational tasks are better suited to become replaced by automation technology (given that they are rooted in explicit knowledge), the automation of these tasks is expected to occur relatively abrupt – with aspects of these tasks more wholly and swiftly enveloped by automation efforts (Lindebaum et al., 2020; Raisch and Krakowski, 2021). This immediacy associated with the process of formal-rational task automation adds to the cognitive displacement of longer-tenured (and more role-embedded) middle managers (Ashforth and Saks, 1995) – as sudden role disruption is paired with extensive obsolescence of the expertise accrued while manually managing explicit information processes.

Conversely, due to their lower embeddedness in past practices, short-tenured middle managers will more readily adopt a ‘role accumulation focus’ post-automation, and more naturally inform organizational strategy through their fresh perspectives that are largely detached from obsolete past routines (Hambrick and Fukutomi, 1991; Sengupta et al., 2008).

It is important to note that we do not infer that long-tenured middle managers will be ‘inflexibly narrow minded’ to unlearn past practices. Instead, we argue that – since formal-rational tasks can quickly and more exhaustively become replaced by automation technology – they may experience more radical role transitions compared to their shorter-tenured counterparts (Ashforth and Saks, 1995; Hambrick and Fukutomi, 1991; Ibarra and Barbulescu, 2010; Nicholson, 1984) and thus, may require extra effort to detach from previously learned practices in favour of role accumulation opportunities that enable them to enhance their strategy involvement. For this reason, the positive impact of formal-rational task automation on middle managers’ strategy involvement will become less pronounced when the middle manager’s position tenure is high.

*Hypothesis 3a:* The positive impact of formal-rational (reporting) task automation on middle managers’ involvement in strategy becomes less pronounced when middle manager position tenure is high.

### **Position Tenure and the Automation of Substantive-Rational Tasks**

In contrast with formal-rational tasks, substantive-rational tasks include both explicit- and tacit-knowledge cues, and thus, their automation often requires human monitoring and intervention to effectively function in its aftermath (Lindebaum et al., 2020; Wijethilake et al., 2018). We have argued that such human-system interaction may promote inefficiencies and role ambiguity to the human actor, which in turn reduces middle managers’ attention to role accumulation opportunities for strategy involvement. Yet, we anticipate that some middle managers will be better suited to deal with the human-system challenges that substantive-rational task automation poses and thus to experience less disadvantages.

Considering *the trade-off between expertise and role-embeddedness of position tenure*, we argue that the expertise advantages that long-tenured middle managers have gained from enacting substantive-rational tasks may outweigh their role embeddedness costs. Substantive-rational tasks include tacit-knowledge cues and are more difficult to wholly replace by an automated system (Raisch and Krakowski, 2021). Prior experience handling tacit knowledge cues allows long-tenured middle managers to better manage the demands of the human-system interface post-automation through their pre-developed expertise. Expertise aids in the recognition of these harder to recognize and integrate knowledge cues when system processes and outcomes fall short. It helps longer tenure middle managers to deal with and mitigate the occurring inefficiencies at the human-system interaction post-automation. In addition, the role-embeddedness costs facing long-tenured middle-managers after substantive-rational task automation will be lower compared to formal-rational task automation – since substantive-rational roles cannot be easily and wholly replaced by technology, i.e., aspects of the middle manager’s previous role-specific repertoire are partially retained post-automation (Lindebaum et al., 2020; Wijethilake et al., 2018).

On the contrary, shorter-tenured middle managers are relatively less equipped with essential expertise to complement the system with recognition or discovery of the multi-dimensional structure, shape and significance of substantive-rational tasks (Lindebaum et al., 2020) – hence they may face more role-ambiguity and more challenging

human-system interaction post-automation (Floyd and Lane, 2000; Rangarajan et al., 2005). That is, even if short-tenured middle managers are less embedded in past practices and routines of their role prior to automation – and would thus be expected to adapt to the new system more readily (Dane, 2010; Sengupta et al., 2008) – their relative lower expertise in parallel with the tacit-knowledge nature of substantive-rational tasks will undermine their relevance in the new and partially automated substantive-rational task context that demands human expertise for its effective functioning. This will heighten role-ambiguity when interacting with the automated system, as their ability to recognize system deficiencies and understanding on how to complement the system is lower. This may trigger several disadvantages. First, it may slow down budgeting procedures – given that they may need more time to comprehend system-generated budget scenarios owing to their relative lack of expertise. Second, they are at higher risk to sign off on budget decisions that do not fully capture associated complexities. Third, given that they would still be expected to co-inform system outcomes via prior knowledge, their inability to do so effectively (due to a relative lack of expertise) may place them on a greater distance from strategic decisions. Overall, these time-related and resource-related (cognitive) constraints will reduce opportunities for shorter-tenured middle managers to realize role accumulation opportunities to inform strategy.

Indeed, studies have shown that substantive-rational tasks follow irregular and hard to predict patterns, and thus, require inclusion of difficult to isolate tacit cues that challenges the current bandwidth of automated approaches (Lindebaum et al., 2020; Wijethilake et al., 2018). Middle managers with longer position tenure will have accrued the appropriate expertise to meet these ongoing requirements where comprehensiveness of system-only approaches falters, offering opportunity to co-inform task outcomes while alleviating the underlying time inefficiencies of substantive-rational task automation (Ferguson and Hasan, 2013; Karaevli and Hall, 2006). Thus, while long-tenured middle managers will be more embedded in the pre-automation approaches of executing substantive-rational tasks compared to shorter-tenured ones (Sengupta et al., 2008), their role embeddedness in prior substantive-rational task roles is less problematic – as the post-automation role carries over expectations and knowledge relevance from their previous role in which they have gained expertise (Lindebaum et al., 2020; Raisch and Krakowski, 2021; Wijethilake et al., 2018). As such, the negative impact of substantive-rational task automation on middle managers' strategic involvement is expected to be less pronounced for long-tenured middle managers compared to their shorter-tenured counterparts.

*Hypothesis 3b:* The negative impact of substantive-rational (budgeting) task automation on middle managers' involvement in strategy becomes less pronounced when middle manager position tenure is high.

## DATA AND METHODS

This study is based on data from the WHU Controller Panel, a large survey-data panel developed at WHU – Otto Beisheim School of Management. This panel has been initiated in 2007 with the aim to assist field research and to identify benchmarks and best

practices for controllers and managers. Based on this panel, surveys are sent out multiple times per year (to approximately 1000 controllers and senior financial managers) across organizations in Germany, Austria, and Switzerland.

From this panel, we used unique data from four survey waves at different points in time. In the summer surveys 2015 (June–August 2015) and 2018 (June–August 2018), we collected data on the level of automation of reporting and budgeting processes, as well as several control variables. In the summer survey 2016 (June–July 2016) and autumn survey 2019 (October–November 2019), we collected data on the strategy involvement of middle managers. Each wave's questionnaire was initially sent out to 931–1117 controllers respectively and senior financial managers – i.e., the target population consists of practitioners and specifically senior controllers of their firms. The response rates of the surveys were between 36 per cent and 47 per cent. This response rate is in line with the average response rate that Mellahi and Harris (2016) have reported in their review for Germany (i.e., 43 per cent).

Prior research defines middle managers as 'general managers who have overall responsibility for a multifunction operation (e.g., strategic business unit managers and divisional heads), as well as functional managers (e.g., a vice president of marketing)' (Dutton and Ashford, 1993, p. 398). Following this conceptualization of the middle management cadre, we therefore only consider answers from the 'heads of controlling' (or senior controllers below the top management level). Hence, we excluded respondents who are either on a higher hierarchical level (i.e., CFOs) or on lower hierarchical levels (e.g., junior controllers). We also excluded respondents from firms with less than 50 employees, i.e., small firms (EU Commission, 2019) as middle managers in small firms are typically more engaged in operational tasks than in organizational strategy (Lubatkin et al., 2006). This means that this study focuses on medium and large companies according to the Eurostat classification.<sup>[1]</sup>

With these procedures, we count 249 respondents that have answered at least one of our four questionnaires. In most survey-based panels, several participants drop out over time. In the longitudinal setting across the four waves of data collection, we therefore assessed the potential attrition bias in our sample (McArdle, 2009). Specifically, we compared our variables of interest between several subgroups. First, we compared the level of reporting automation and budgeting automation as well as middle managers' position tenure in 2015 between respondents who answered in 2015 only but not in 2018 with answers provided by respondents who answered in 2015 and in 2018. Based on two-tailed t-test, we did not find any significant differences ( $p > 0.05$ ). Similarly, we compared the involvement in strategy measured in 2016 between respondents who answered in 2016 only but not in 2019 with the responses of middle managers who participated in both surveys – 2016 as well as 2019. Again, we did not detect any significant differences ( $p > 0.05$ ).

Finally, we tested for a non-response bias by comparing the answers of the 25 per cent early respondents with the 25 per cent late respondents of each single survey wave. The key assumption here is that late respondents are similar to non-respondents (e.g., Armstrong and Overton, 1977). Based on the results of the t-tests we detected significant differences between early and late respondents only in one dimension. Namely, in the 2018 survey the early respondents reported significantly ( $p < 0.05$ ) higher levels of budgeting automation than their late peers. For all other variables in all four waves no significant differences between early and late responses were detected. It is also worth noting that the difference for automation budgeting in 2018

is no longer significant when we relax our assumption and compare the early 33 per cent to the late 33 per cent of respondents as also applied by Becker et al. (2016) (instead of the conservative 25 per cent threshold we used originally). Further, to ensure that response bias is unlikely to threaten our results, we additionally conducted the Kolmogorov–Smirnov two-sample test (e.g., Tuggle et al., 2022). This test allows us to examine whether the two samples differ in terms of the distribution of budgeting automation. Test results were not significant – suggesting that the observed differences are not referring to the distribution of the two groups. This result together with the relatively high and constant response rates over the four survey waves underline that response bias is unlikely to threaten our results.

## Measures

*Dependent variable.* *Strategy involvement* of middle managers was measured following the approach suggested by Wooldridge and Floyd (1990), which has been widely applied in the middle management literature (Heyden et al., 2017; Heyden et al., 2020) including studies in the management accounting context (e.g., Cadez and Guilding, 2008). Respondents were asked to give answers on a seven-point Likert scale as to what extend they are involved in: ‘(1) identifying problems and proposing objectives, (2) generating options, (3) evaluating options, (4) developing details about options, and (5) taking the necessary actions to put changes into place’ (Wooldridge and Floyd, 1990, p. 235). The scale ranged from 1 = ‘not at all involved’ to 7 = ‘fully involved’. Cronbach’s alpha for both measurements in 2016 and 2019 is above 0.92, indicating high reliability. Consistent with prior work, we used the mean of the five items as our dependent variable.

*Independent variables.* Reporting automation and budgeting automation have been measured with a single item question. Specifically, we asked: Please name the percentage of processes that have been automated (0 = no process automated ... 100 = all processes automated) for reporting (similar for budgeting). We subsequently transformed the score to range from 0 to 1 before inclusion in our empirical model. Since heads of controlling are responsible for reporting and budgeting processes (Weber, 2011), we expect reliable answers. However, research has shown that perceptions of individuals about the degree and importance of automation alter over time, due to the rapid technological advancements that occur in the application of automation (von Krogh, 2018). To account for between-year automation differences, we adjusted the level of automation of reporting and budgeting by the year average level of automation of reporting and budgeting respectively (i.e., for 2015 and 2018). This allows us to consider year-differences on how respondents perceive automation levels based on the different standards of each year of assessment.

*Moderator and control variables.* To measure *position tenure*, respondents were asked to indicate how long they worked in their current position (as head of the controlling department) in the focal organization. High scores indicate high position tenure. Following suggestions from prior studies (Becker et al., 2019; Russell and Dean, 2000), we decided not to transform this variable. Using linear terms facilitates the direct

interpretation of our results. In this regard, our interaction terms in the analyses are constructed as the multiplication of our untransformed position tenure variable, and the two independent variables (i.e., the year-adjusted reporting and budgeting automation respectively). In a supplementary test, we also conducted our analysis with position tenure transformed to its natural logarithm – given the relative high skewness observed in this variable. Results were consistent to those with the untransformed moderator variable presented in Table II – and are available from the authors on request.

To account for potential confounding factors, we included several control variables at the individual and firm levels. For individual level aspects, we controlled for respondents' *age* and *firm tenure*. Indeed, firm tenure, measured as the number of years the middle manager is working for the firm, has been seen in the prior literature as a key indicator of an individual's firm specific skills and human capital specialization that may impact organizational strategy (Georgakakis and Ruigrok, 2017; Harris and Helfat, 1997; Karaevli and Zajac, 2013). In addition, although age has been regarded by several studies as a socio-demographic trait (Kunze et al., 2011), scholars have also argued that older individuals possess a larger amount of experience and knowledge (Georgakakis and Buyl, 2020; Herrmann and Datta, 2006). To account for these aspects, we controlled for each individual middle manager's age, measured from the year of his or her birth and up to each respective year of observation.

Further, at the firm level, we controlled for *firm size*, measured as the numbers of employees, and *firm age*, measured as the years since the organization was founded. We also controlled for *firm performance*, *firm strategy*, and *perceived environmental uncertainty*. We measured *firm performance* on a 7 point Likert scale by asking respondents about their assessment of the return on investment of their organization compared to their peer organizations and direct competitors (1 = 'totally disappointing' ... 7 = 'excellent'). We measured *firm strategy* on a single item scale (Shortell and Zajac, 1990). Respondents were asked to indicate how they would describe the strategic orientation of their firm, based on a continuum from 1 = 'cost leader' to 7 = 'product differentiator'. *Perceived environmental uncertainty* was measured with a single item question on a 7 point Likert scale (1 = 'very low uncertainty' ... 7 = 'very high uncertainty'). Indeed, prior studies have shown that environmental characteristics are important indicators of how organizational actors engage in strategy formation (Van Doorn et al., 2017). Moreover, to account for macro-level effects, we also controlled for year and industry dummies. Precisely, we included a dummy variable *manufacturing* that has the value of 1 if the focal organization is a manufacturing firm and 0 otherwise. In addition, we controlled for the baseline years of assessment – 2015 and 2018 – as these years represent the respective t0 in our analysis that may affect strategic involvement in subsequent years (i.e., 2016 and 2019, respectively).

## RESULTS

Table I presents descriptive statistics and correlations. Table II presents results of our main analysis. Scholars stress that in panel data analysis, a generalized least

Table I. Descriptive statistics and correlations

	<i>Variables</i>	<i>Mean</i>	<i>SD</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>
1	Strategy involvement	4.174	1.346	1											
2	Reporting automation	0.033	0.241	0.113	1										
3	Budgeting automation	0.044	0.251	−0.008	0.629*	1									
4	Middle manager position tenure	7.258	6.324	−0.200*	0.116	0.212*	1								
5	Middle manager firm tenure	13.651	8.203	−0.092	0.221*	0.226*	0.621*	1							
6	Middle manager age	47.394	7.740	−0.126	0.085	0.244*	0.464*	0.495*	1						
7	Firm size	11550.41	36914.54	0.044	0.046	0.004	−0.100	−0.050	0.068	1					
8	Firm age	72.951	49.735	0.083	0.120	0.104	0.067	0.170*	0.078	−0.043	1				
9	Firm strategy	5.341	1.233	0.108	0.010	−0.017	−0.006	0.078	0.021	−0.066	0.049	1			
10	Firm performance	4.416	1.304	0.115	−0.020	−0.012	0.165*	0.144	0.059	−0.046	−0.085	0.199*	1		
11	Perceived environmental uncertainty	4.459	1.410	0.068	0.046	−0.036	−0.240*	−0.078	−0.046	0.046	0.142	0.025	−0.190*	1	
12	Manufacturing firm	0.649	0.479	−0.103	0.022	0.011	−0.180*	−0.114	−0.064	−0.084	0.085	0.176*	−0.034	0.200*	1

Note: N = 185.

\*p < 0.05.

squares (GLS) regression technique fits better than a simple ordinary least squares (OLS) regression, as it allows to adequately account for cross-sectional heteroskedasticity and within unit autocorrelation (Cannella Jr et al., 2008; Kalogeraki and Georgakakis, 2022). Given the panel nature of our sample, we therefore employ a random-effects GLS regression technique (using the *xtreg* command in Stata 17). To check whether our results are affected by multicollinearity, we conducted variance inflation factor (VIF) tests in Stata 17 after an OLS regression (Cannella Jr et al., 2008). Results show that the average VIF of our three models ranged from 1.29 to 2.56, with all individual VIF scores being well below the threshold of 10 (Neter et al., 1990). Further, as Table I shows, reporting and budgeting automation have opposing (positive and negative respectively, albeit not statistically significant) correlations with our dependent variable (strategy involvement). Thus, although these variables are correlated with an  $R = 0.63$ , they exhibit opposite effects on strategy involvement – confirming their independent nature in affecting the individual middle manager's strategic role.

Hypothesis 1 suggests that there is a positive impact of formal-rational task (i.e., reporting) automation on middle manager strategy involvement. Our main model in Table II does not provide significant support for this hypothesis. While the regression coefficient indeed has a positive direction, the effect is not statistically significant ( $\beta = 0.57$ ;  $p > 0.05$ ). As we explain below, however, this effect turns significant when the contingency role of position tenure is taken into consideration and the interaction effect of position tenure and budgeting-task automation is also accounted for in the analysis, highlighting the contingent nature of this effect (Karaevli and Zajac, 2013). Further, Hypothesis 2 implied that the automation of substantive-rational tasks (i.e., budgeting) has a negative impact on middle manager strategy involvement. Similarly, while the regression coefficient is negative as expected, it is also not statistically significant ( $\beta = -0.10$ ;  $p > 0.05$ ). Yet, this effect turns significant in Model 3 when the interaction effect of position tenure is considered, and the interaction effect of position tenure and budgeting-task automation is also accounted for in the analysis.

Hypothesis 3a posits that middle managers with high position tenure would mitigate the positive impact of reporting automation on middle managers' strategy involvement. Indeed, Model 3 in Table II substantiates this hypothesis ( $\beta = -0.30$ ;  $p < 0.01$ ). To further investigate this interaction effect, we plotted the slopes as presented in Figure 1. We also examined the slope significance of this interaction effect. Results support a positive and significant slope as compared to the x-axis (slope coefficient = 2.50;  $p < 0.01$ ) for shorter-tenured middle managers ( $-1SD$ ). For longer-tenured middle managers ( $+1SD$ ) we find a negative slope that is marginally significant in terms of difference from the x-axis (slope coefficient =  $-1.27$ ,  $p < 0.10$ ). Our interpretation is as follows: When the level of reporting automation is low, short- and long-tenured middle managers engage in similar levels of strategy involvement. Yet, with higher levels of reporting automation, short-tenured managers engage significantly more in strategy compared to their longer-tenured counterparts.

Hypothesis 3b suggested a mitigating effect of position tenure on the negative impact of budgeting automation on middle managers' strategy involvement. Model 3 in Table II supports this hypothesis ( $\beta = 0.28$ ,  $p < 0.01$ ). As for the interaction effect

Table II. Panel regression with middle manager strategy involvement as dependent variable

<i>Variables</i>	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>
Intercept	3.630*** (0.875)	3.666*** (0.879)	3.374*** (0.863)
Firm size	0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)
Firm age	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)
Firm strategy	0.105 (0.079)	0.109 (0.080)	0.115 (0.077)
Firm performance	0.129 (0.078)	0.126 (0.078)	0.174* (0.076)
Perceived environmental uncertainty	0.098 (0.071)	0.091 (0.072)	0.094 (0.069)
Manufacturing firm	−0.447* (0.224)	−0.459* (0.225)	−0.403 (0.219)
Middle manager age	−0.014 (0.016)	−0.013 (0.016)	−0.012 (0.015)
Middle manager firm tenure	−0.000 (0.016)	−0.004 (0.017)	−0.004 (0.016)
Middle manager position tenure	−0.042 (0.022)	−0.043* (0.022)	−0.052* (0.023)
Reporting automation		0.570 (0.510)	2.777** (0.844)
Budgeting automation		−0.096 (0.468)	−2.149** (0.741)
Middle manager position tenure × Reporting automation			−0.298** (0.089)
Middle manager position tenure × Budgeting automation			0.282** (0.081)
Observations	185	185	185
Number of middle managers	153	153	153
R <sup>2</sup> (overall)	0.111	0.128	0.157
Wald $\chi^2$	19.12*	20.79	35.78**

*Note:* Unstandardized coefficients; standard errors in parentheses; year dummy included.

\*\*\*p < 0.001, \*\*p < 0.01, \*p < 0.05.

of budgeting automation and the position tenure, we find a positive slope (slope coefficient = 1.69,  $p < 0.05$ ) for longer-tenured middle managers (+1SD) and a negative slope (slope coefficient = −1.89,  $p < 0.01$ ) for shorter-tenured middle managers (−1SD). Our interpretation of the plot in Figure 2 is that for low overall levels of budgeting automation shorter-tenured middle managers engage significantly more in strategy involvement compared to their longer-tenured counterparts. However, for

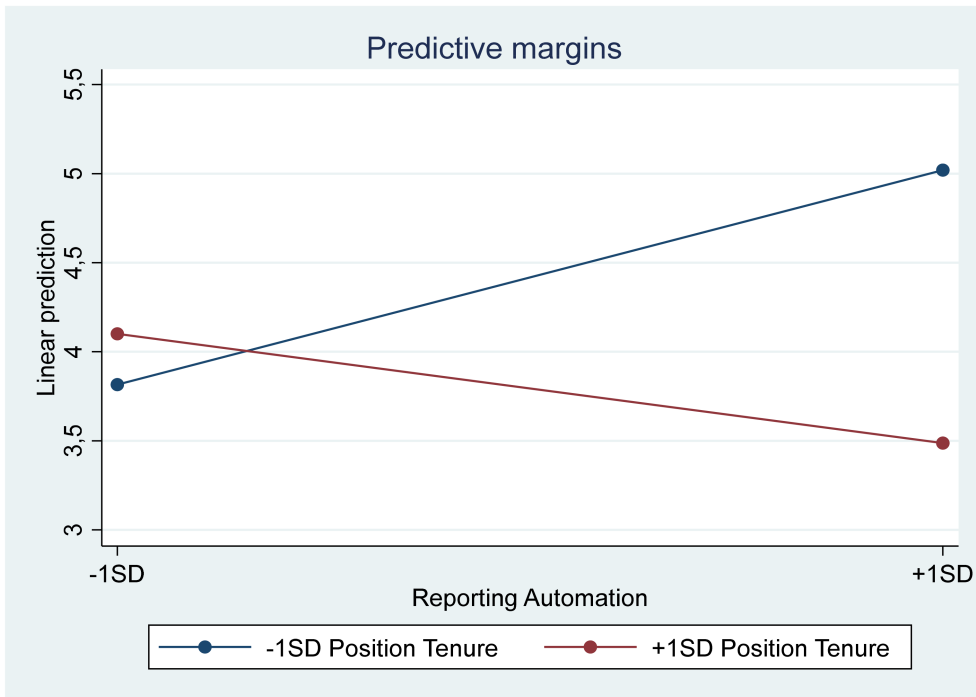


Figure 1. Interaction plot reporting automation and position tenure

higher levels of budgeting automation shorter-tenured middle managers display diminishing involvement in strategy. In contrast, longer-tenured middle managers are involved significantly more in strategy for higher levels of budgeting automation. These findings are in line with Hypothesis 3b, providing support for our associated arguments.

### Common Method and Endogeneity Tests

We took several steps to account for potential common method and endogenous bias that may threaten the validity of our results. First, we collected the data of our independent (IVs) and dependent (DVs) variables in separated questionnaires and at different points in time. In addition to this temporal separation, we also decided to use different response formats such as 7-point Likert scales for our DV as well as percentage ranges for our IVs, which also reduces common method concerns (Podsakoff et al., 2003). This provides an initial foundation for our conclusion that our various variables are not determined by common measurement methodology. In addition, our panel survey research design allows us to observe responses at different points in time. Indeed, scholars have stressed that the use of longitudinal (instead of single-year cross sectional) samples is one of the most efficient research design techniques for dealing with potential common methods bias, as it allows to consider responses at different time points (Lindell and Whitney, 2001; Malhotra et al., 2006). Second, most respondents have built trust in this panel over their participation in many waves of

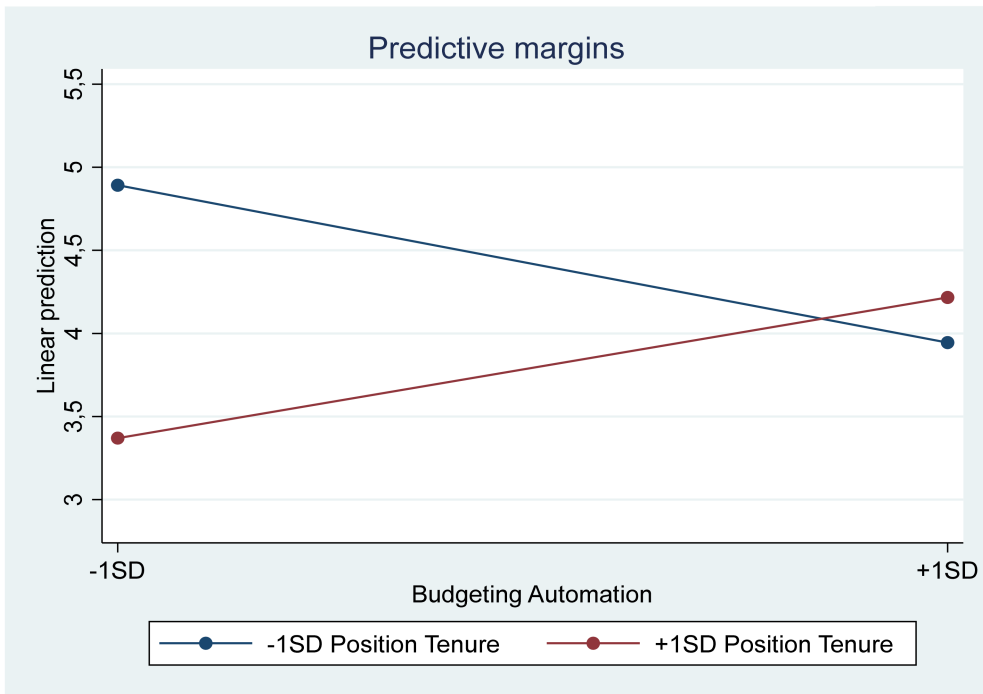


Figure 2. Interaction plot budgeting automation and position tenure

data collection. They have thus experienced that their answers are treated confidentially, and that respondents' anonymity is strictly protected, which reduces their tendency to give answers in a socially desired way (Lindell and Whitney, 2001; Solarino and Aguinis, 2020).

Further to our research design choices, we also used statistical controls to test for potential common method issues. First, we conducted the Harman's single factor test to check whether a factor accounted for the majority of the variance. The exploratory factor analysis resulted in a factor that accounted for less than 50 per cent of variance, indicating that common method bias is not an important concern in our study (Podsakoff et al., 2003). Yet, while the Harman single factor test is widely used, scholars have raised concerns as to whether this is an appropriate response to common method issues (e.g., Malhotra et al., 2006). Recent research has demonstrated that the issue of common method bias can be detected and dealt with endogeneity analysis techniques, and by adopting an appropriate research design (Antonakis et al., 2010). In addition to common method issues, our analysis may also be subject to potential endogeneity. A potential endogeneity issue may occur from the reasons that drive firms to automate. For example, the firm's dominant coalition (i.e., the top management team) may decide to automate with the direct purpose to make middle managers either more or less influential on strategic decision making – leading to potential endogeneity concerns.

To address these aspects, we followed prior studies and applied a 2SLS and the associated Durbin and Wu–Hausman tests to detect for such potential endogenous bias in our analysis. According to Semadeni et al. (2014), to adequately detect endogeneity, scholars should use more than one instrumental variable. Such instrumental variables need to be associated with the independent variable (in our case reporting and budgeting automation), and non-related with the dependent variable (in our case middle manager strategic involvement). In an example of three instruments, the authors also highlight the importance of studies to consider both instrument strength (using the associated first-stage F test and if it is higher from the critical values), as well as instrument validity (versus overidentification) using the associated Basman and Sargan tests.

Accordingly, we used the following three instruments: (a) the year-adjusted average level of reporting and budgeting automation of firms that fall in the same public versus private status category as the focal firm (considering listed versus non-listed firms) excluding the focal firm; (b) the year-adjusted average level of reporting and budgeting automation in the firm's industry (considering manufacturing versus other industries) excluding the focal firm; and (c) the year-adjusted average level of reporting and budgeting automation in firms of the same size category as the focal firm (considering medium-sized enterprises versus large firms based on the EU definition) excluding the focal firm. The theoretical logic behind the selection of these instrumental variables is as follows: Firms are likely to follow mimetic tendencies related to automation by considering the actions of other firms of similar size, trading status, and industry categorization as themselves (Benders et al., 2006). Such isomorphic tendencies may lead listed firms to adopt similar reporting and budgeting automation tendencies, a process that is further founded on similarities in external auditing standards across firms of similar size, trading-status, and industry categorization. Yet, it is unlikely that these macro-level isomorphic tendencies in the focal firm's external environment (excluding the focal firm) would influence individual middle managers involvement in strategy in the focal organization, given that they operate more at the unit level while interfacing with intra-firm constituents (Cadez and Guilding, 2008; Rouleau and Balogun, 2011).

To empirically test the suitability of our selected instruments, we conducted the *first-stage* test as well as the Sargan and Basman tests in Stata 17. The *first-stage* test informs us about the strength of our instruments, while the Sargan and Basman tests examine the validity of our instruments and the potential threat of over-identification. Results of the *first-stage* test supported the suitability of the selected instruments ( $F = 1515.23$ ;  $p < 0.001$  for reporting automation;  $F = 1448.89$ ;  $p < 0.001$  for budgeting automation). The observed F-statistic was above all critical values in the 2SLS nominal 5 per cent Wald test, confirming that our instruments are strong. Further the Sargan and Basman tests were not significant ( $p > 0.05$ ), suggesting that our instruments are valid and that our model is correctly specified. Subsequently, we run the Durbin and Wu–Hausman tests using the *estat endog* command in Stata 17 to detect for potential endogeneity. For reporting automation, the Durbin test is at  $\chi^2 = 0.99$ ;  $p$ -value = 0.32, and the Wu–Hausman test is at  $F = 0.92$ ;  $p = 0.34$ . For budgeting automation, the Durbin test is at  $\chi^2 = 0.23$ ;  $p$ -value = 0.63, and the Wu–Hausman test is at  $F = 0.21$ ;  $p = 0.65$ . This indicates that endogeneity is not a concern for either of the two variables. Results of the above common method and endogeneity analyses are available from the authors upon request.

Beyond the above efforts to quantitatively test and address common method bias and endogeneity concerns, we also conducted 8 post-hoc semi-structured qualitative interviews with the purpose to give more substance to our understanding of how middle managers perceived reporting and budgeting tasks – and how these perceptions align with the notions of formal- and substantive-rational tasks. Indeed, the value of testing concepts and constructs with post-hoc qualitative methods has been recognized by prominent scholars in the field (see e.g., Ates et al., 2020). We provide a detailed report of the relevant insights obtained from the post-hoc qualitative interviews in the [Appendix 1](#). Overall, from this concise set of semi-structured interviews, we observe the following aspects: reporting was classified as a routine and easy to automate task – that can easily and largely replace the human actor's role post-automation. At the same time, budgeting is a more advanced and forward-looking task that is more challenging to automate – and demands a more intense human-system interaction and monitoring post-automation.

## DISCUSSION

This study unveils how automation technologies that deeply permeate in middle managers' task contexts influence their strategy involvement (Wooldridge and Floyd, 1990). We have argued that, *ceteris paribus*, the automation of formal-rational tasks (i.e., tasks that are routine-based and explicit-knowledge oriented) offer time-capacity benefits for middle managers to realize role-accumulation opportunities and enhance their influence in strategy formation. Meanwhile, we have maintained that the automation of substantive-rational tasks (i.e., tasks that involve both explicit- and tacit-knowledge cues) will *ceteris paribus* have a negative impact on middle managers' strategic involvement. Our empirical findings support most of our predictions, by showing that – while wholly contingent on the middle manager's position tenure – reporting and budgeting automation have differential effects on middle management involvement in strategy. Overall, our research highlights the complex and contingent nature of the relationship between middle management task automation and strategic involvement, offering several contributions.

First, our work advances middle management research (Floyd and Wooldridge, 1992) by offering conceptual nuance on how the formal-rational and substantive-rational roles of middle managers, and their strategic involvement, alter when different parts of their task contexts are automated. Some scholars adopt an '*automation-as-a-threat*' view to argue that digital automation reduces middle-managers' strategic value (Acemoglu and Restrepo, 2019, 2020; Brynjolfsson and McAfee, 2014). Yet, others subscribe to an '*automation as an opportunity*' perspective (Autor, 2015) to highlight that automation can generate role accumulation opportunities (von Krogh, 2018), enabling middle managers to engage more actively in the strategy processes (Bloom et al., 2014; Raisch and Krakowski, 2021). Bringing these seemingly contradictory views together, we suggest that neither of the two conceptualizations can fully capture the complex impact of digital automation and middle managers' strategic influence. It stresses that a key aspect for unravelling this controversy is the nature of the task that becomes automated in interaction with the individual-level attributes of the middle manager.

Namely, our results show that, *per se*, formal-rational task automation (i.e., reporting) does not have a significant effect on middle managers' strategy involvement. Yet, this effect activates when the key contingent impact of position tenure on the relationship between formal and substantive rational tasks and strategy involvement is taken into consideration. As [Figure 1](#) depicts, when formal-rational task automation proliferates, long-tenured middle managers are less likely to enhance their strategic involvement compared to their shorter-tenured counterparts. This aligns with our arguments that – due to the nature of formal-rational task automation and its tendency to more autonomously enact the reporting task without the participation of a human actor (Lindebaum et al., 2020; Raisch and Krakowski, 2021) – its positive effect on strategy involvement will be less pronounced for long-tenured middle managers (compared to their shorter-tenured counterparts). In this context, the expertise benefits of long-tenured middle managers in performing formal-rational tasks appear to be outweighed by their role embeddedness costs in the aftermath of formal-rational task automation, since: (a) their experience-depth in performing the reporting-task loses value (the task can be performed more autonomously by the system with few human-actor interventions), and (b) the role transition is more radical as the reporting task is more wholly replaced by automation – causing cognitive displacement to long-tenured middle managers (Ashforth and Saks, 1995; Ibarra and Barbulescu, 2010; Nicholson, 1984) – thereby requiring from them an extra effort to detach from past practices and engage in the realization of role accumulation opportunities for strategy involvement. Conversely, short-tenured middle managers will more readily adopt a 'role accumulation focus' when formal-rational tasks are automated, and influence strategy through perspectives that are more detached from former and post-automation obsolete practices (Hambrick and Fukutomi, 1991; Sengupta et al., 2008).

The above arguments align with the base-line assumptions of role theory that roles are malleable (Biddle, 1986), and role transitions (Ashforth and Saks, 1995; Nicholson, 1984) explain how routine-based job descriptions and expectations are redefined by changes induced in the social system (Georgakakis et al., 2022; Raes et al., 2011). Indeed, scholars have recognized that when prior roles and the value of expertise in performing these roles become obsolete post-automation (Raisch and Krakowski, 2021), individuals embedded in prior role assumptions require an extra effort to transit to the new task context and benefit from associated opportunities (Becker, 2005; Biddle, 1986; Georgakakis et al., 2022; Karaevli and Hall, 2006). Formal-rational tasks have a strong explicit-knowledge orientation and are subject to become more wholly replaced by automation (Raisch and Krakowski, 2021). Long-tenured middle managers, then – albeit more experienced in these tasks – are also relatively more embedded to the associated prior routines that become obsolete post-automation. Thus, compared to their shorter-tenured counterparts, they appear to benefit less from formal-rational task automation in terms of strategy involvement. To this end, our study advances our current understanding of how the induction of a non-human social entity in the organization's social system (i.e., automation technology) is likely to differentially impact individual middle managers – and determine their eventual impact on organizational strategy.

Beyond formal-rational tasks, we have also argued that substantive-rational (budgeting) task automation will, *ceteris paribus*, have negative effects on middle managers' strategic

involvement. The difference between formal- and substantive-rational tasks is that the former is purely based on explicit knowledge, while the latter involves tacit-knowledge cues and thus requires human oversight and monitoring in the automation's aftermath for its effective operation (Lindebaum et al., 2020; Raisch and Krakowski, 2021; Wijethilake et al., 2018). The continued monitoring of hard to isolate tacit knowledge cues will – ceteris paribus – cause time inefficiencies and preoccupation of middle managers to fill gaps in the system, an aspect that we argued would undermine role accumulation and strategic involvement. Our results in Model 1 show that, when budgeting automation is considered in isolation, it does not have a significant effect on strategic involvement. Yet, in the full model (Model 3), this effect gains in significance when position tenure is considered as a key boundary condition – and its simultaneous effect on the relationship between reporting-automation and strategy involvement is also considered.

With regard to the key moderating role of position tenure, Figure 2 illustrates that while short-tenured middle managers are likely to experience more pronounced disadvantages from substantive-rational task automation in terms of their strategy involvement, long-tenured middle managers may be better placed to inform strategy as substantive-rational tasks automate. The tacit-knowledge component of substantive-rational tasks (Lindebaum et al., 2020; Raisch and Krakowski, 2021; Wijethilake et al., 2018) enable long-tenured middle managers with deep expertise to better and more efficiently resolve system deficiencies. In addition, given that substantive-rational tasks are more difficult to automate and are less likely to wholly replace the human actor (Raisch and Krakowski, 2021; Wijethilake et al., 2018), long-tenured middle managers may experience less role embeddedness costs – as their role is partially retained and their expertise offers continued value at the human-system interface post-automation. In this context, the expertise benefits outweigh the role embeddedness challenges of long-tenured middle managers – enabling them to inform strategy from the cues that emerge as they co-inform the substantive-rational function more efficiently. On the contrary, despite their lower embeddedness, the relative lack of expertise of short-tenured middle managers strengthens time inefficiencies and role ambiguity as they try to make sense of the human-system interface post-automation – triggering a more pronounced negative impact of substantive-rational task automation on their strategy involvement.

Indeed, this aspect is in line with prior studies stressing that experts with knowledge-depth benefit from role-accumulation opportunities that emerge at the human-system interface only when the altering task context is tacit-knowledge based and requires human expertise in the role transition (Karaevli and Hall, 2006). We also observe that – at low levels of substantive-rational task automation – long-tenure middle managers experience a more significant gap with their shorter-tenured counterparts for strategy involvement, but this gap diminishes as substantive-rational task automation proliferates (see Figure 2). This aspect is also in line with the arguments of Raisch and Krakowski (2021) and von Krogh (2018), which stress that human expertise may gain value and facilitate the accumulation of more influential roles when automation associates with tacit-knowledge cues, and when complex human-system interaction processes emerge in the face of automation. As such, the expertise advantages of long-tenured middle managers will outweigh their higher role embeddedness challenges – enabling them to adopt more central roles in strategy formation. To this end, our study contributes toward the development of

a more detailed understanding about how automation of different aspects of the middle-manager's task context, in interaction with their position tenure, differentially influence their strategic involvement.

Beyond the above, our study's findings provide implications that are relevant to our specific focus on middle managers in the accounting and controlling function – a function which has been regarded as frontline to automation (Moeller et al., 2020). The head of controlling represents a typical type of middle manager that exists in almost every organization, as they are the linking pin between controllers on lower hierarchical levels and the top managers at the senior levels (Merchandts and Van der Stede, 2017). In their tasks, they balance both routine-based (formal-rational) duties as well as future-oriented substantive-rational functions (Moeller et al., 2020). Recent studies have underscored that the strategic role of controllers may be partially enveloped as automation technology proliferates in the accounting function (Moll and Yigitbasioğlu, 2019). Yet, others underscore the importance for heads of controlling to use their expertise and connect with digitalization opportunities that enable them to advance their strategic importance (Oesterreich et al., 2019). Emphasizing two key tasks of different nature that pertain to the controllers' role – reporting and budgeting (Moeller et al., 2020) – our research stresses that long-tenured middle management controllers differ in terms of strategic influence from their shorter-tenured counterparts when tasks of different calibre become automated. Viewed in tandem, our work underscores that the way middle manager role transitions affect their influence on organizational strategy varies at the intersection of the nature of the task that becomes automated, as well as the individual middle managers' characteristics. In this regard, our work acts as a bridge between the role-theoretical tradition and the literature on digital transformation in contemporary organizations – by showing how roles of individuals at the middle-rank can be moulded with the proliferation of formal- and substantive-rational task automation.

## Practical Implications

Our study offers a set of practical parameters that organizations and middle managers should consider as automation technology proliferates in their task context. First, it reveals that the impact of digital automation on middle managers' strategic involvement is co-dependent on the nature of the tasks subject to automation. Since involving middle managers in strategy formation constitutes an effective means to enhance information processing in strategic decision making (Ou et al., 2017), and as the middle-rank is the natural internal pool for populating senior executive positions (Heyden et al., 2018), firms and executives that seek to benefit from middle managers' inputs and their bottom-up influence should be mindful when concluding which tasks to automate. It is also important to note that our study focuses on middle managers' strategic involvement, rather than on how automation impacts the attrition and size of the organization's middle-rank. Given that middle managers provide the natural internal talent pool for populating senior executive posts (Georgakakis et al., 2018; Heyden et al., 2018), the downsizing of the middle-management labour post-automation is unlikely to entirely eliminate the middle rank, but would still consider the retention

of individuals who can inform advanced strategic processes through bottom up means of influence (Govindarajan et al., 2021; Heyden et al., 2017, 2018). Hence, instead of considering whether automation is likely to reduce (or increase) the number of middle managers in the organization, our study focused on how the roles of middle managers who remain in the organization post-automation and their strategic influence are affected.

Indeed, scholars have repeatedly argued that middle managers are an important source of managerial talent, and hence, the firms' potential future senior executives (e.g., Claussen et al., 2014; Heyden et al., 2017). In this regard, our study sounds a cautionary note for firms concerning how beneficial automation can be in providing role accumulation opportunities for individuals in the middle-rank that are retained post-automation to engage in strategy formation and prepare to take on subsequent (through internal promotion) senior managerial posts in the organization. Some middle managers may need more effort than others to transit to a new role-specific task context post-automation and realize role accumulation opportunities for contributing to strategy formation. This depends on how automation impacts their expertise versus role embeddedness trade-off in the role transition, and how this influences role accumulation processes in the automation's aftermath (Hambrick and Fukutomi, 1991; Ibarra and Barbulescu, 2010; Nicholson, 1984).

For example, when automating formal-rational tasks, firms should also take measures to ensure that middle managers are offered adequate time and support to detach themselves from past practices when their formal-rational roles become largely captured by the system. To achieve this, formal-rational task automation could be paired with clear directives to give deeper interpretation of the now automated explicit-knowledge provision – facilitating the role transition and the realization of role accumulation opportunities for the middle rank. Similarly, prior to automation, firms can take measures for ensuring that substantive-rational task automation will be introduced in a way where both long- and shorter-tenured middle managers are able to establish effective human-system interactions, and thus, realize role accumulation processes that enhance their strategic impact. This may require a coordinated approach mapping formal- and substantive-rational tasks that have not yet been automated, as well as carefully measuring the impact of automated tasks on middle managers' strategic contributions.

Further, it may be that not all forms of substantive-rational task automation translate unfavourably on middle-managers' involvement in strategy. This may also vary with how the system operates. As automation approaches become more advanced and autonomously capture the role of the human actor, individual middle managers may need to prepare themselves for exploring additional ways to ensure their continued relevance – as well as to go beyond embeddedness in prior roles to advance in the altering social system (Govindarajan et al., 2021). Middle managers retained in the firm post-automation should therefore establish processes that enable them to coexist with automation technology in a way that advances their strategic impact and contribution. For example, it will be interesting to monitor how human-system interaction evolves in the face of expanding and smarter automation applications – such as different forms of artificial intelligence – and how individuals with different skills and knowledge-transfer ability

(Karaevli and Hall, 2006) are influenced by the application of advanced technology. For now, our study highlights that the use of automation technology in relation with the task in which this technology proliferates is critical for the middle-management cadre and its strategic importance.

## Limitations and Future Research

The contributions of our study should be considered in parallel with its limitations that highlight promising research avenues. First, one limitation in the middle management literature pertains to the broad definition of middle managers. Given that the middle rank of the organization varies not only across firms but also across functions within organizations, it is difficult to specify the middle management term in a way that is consistent across contexts (Reimer et al., 2016b; Wooldridge et al., 2008). In this study, we research a specific middle manager function that exists in almost every organization, i.e., the head of the controlling unit. While this middle manager is engaged with both formal- and substantive-rational tasks (Weber, 2011), there are some distinct features of this function that may limit how our findings resonate with middle management roles in other organizational functions. For instance, as the head of controlling, our middle manager is directly overseeing resource allocation of both existing and new activities within the organization (Weber, 2011). At the same time, they have an advantaged role when it comes to information provision, increasing their awareness of organizational developments. Other middle managers that are less centrally positioned in the firm may be less inclined to be involved in organizational strategy, and thereby our findings may not necessarily generalize to their task contexts. In addition, middle managers in other functions may have rather skewed engagement with substantive- versus formal-rational tasks e.g., the head of an R&D department whose role is often future-oriented and tacit-knowledge based (Brennecke et al., 2021) – or may more frequently interact with the CEO and other executives to influence strategic choice (Cannella Jr and Georgakakis, 2017; Georgakakis et al., 2022; Van Doorn et al., 2022). Our findings on formal-rational task automation then may be less applicable in these contexts. Yet, our findings about substantive-rational task automation may be stronger in such contexts. By adopting the formal-rational versus substantive-rational task distinction, future research can shed light on this topic.

Another interesting avenue of future research pertains to the various characteristics of middle managers beyond the observed role of position tenure. Clearly, long-tenured middle managers will differ from each other in terms of how embedded they are in prior roles, and how easily they can transit to the new context. While our study emphasizes the distinction of long- versus short-tenured middle managers, future research can examine how deep-level characteristics of those individuals such as self-efficacy (Morrison and Brantner, 1992), openness in personality (Harrison et al., 2019) or locus of control (Boone and Hendriks, 2009) may influence how middle managers of similar position tenure adapt to a role-transition induced by the automated context. While capturing these individual-level attributes is beyond the scope of this study, future studies can adopt other research designs (e.g., experiments) to examine how the patterns we observed may vary with middle managers' deep-level traits and perceptual filters. This micro-level

focus will help enhance our understanding on how individual members of the middle-management cadre may be differentially affected by the automation of formal-rational and substantive-rational tasks.

A related avenue for future research would be to consider the role of artificial intelligence (AI) as a special form of automation that differentially influences middle managers' strategy involvement. Studies have argued that AI may more easily replace human involvement with the task at hand – and may thereby have a differentiated impact on how middle managers build role accumulation as AI proliferates their various task contexts (Haefner et al., 2021). In a recent study, Govindarajan et al. (2021) show that advanced AI applications can significantly downsize the middle-rank in contemporary organizations. Future research can endeavour to make distinctions in the critical mass represented by automation efforts and consider how AI applications may influence substantive-rational task processes post-automation. It is important to note, that due to the complex and evolving nature of AI applications, there may be different AI categories to consider that may have differential impact on the human-system interaction, and thereby may distinctly influence the roles of middle managers in contemporary organizations. Future research in this area could therefore account for the complex nature of AI applications and use qualitative research designs – such as multiple case studies (Gibbert et al., 2008) – to consider how e.g., 'reactive machines' differ from 'theory of mind' AI applications. Such distinction can shed light on how these approaches of different complexity in AI impact the middle-rank's strategic importance.

Relatedly, considering that automation technology may affect the size of the middle-rank in the organization, one can assume that those middle managers who are retained after digital transformation may be more likely to engage in strategy formation. At the same time, when the firm specifically adopts automation technology for downsizing purposes, one could also assume that remaining middle managers' importance will also diminish (Wesche and Sonderegger, 2019). It is then interesting to consider in more detail which middle managers remain and what roles they adopt as automation proliferates. Clearly, the reasons that middle managers may leave the organization after digital transformation may vary – including voluntary departure due to e.g., other career opportunities, natural retirement, health or personal reasons, or involuntary dismissal (Georgakakis and Buyl, 2020). While exploring the reasons of middle management turnover is beyond the scope of our study – which focuses on differences in strategic influence among those middle-managers who remain post-automation – future research can use experiments and other research designs to address this interesting topic. For example, using experiment methods, future research can test how decision makers will be retained versus replaced in middle-management ranks in the aftermath of formal-rational and substantive-rational task automation, and if after retention in the post-automation context the remaining middle managers generally adopt more strategic roles. Such an experimental approach may help to further elucidate the causal processes through which automation differentially impacts different members of the firm's middle-rank. Another aspect relates to the opportunity for running fixed effects models to better account for within-unit differences of individual middle managers. Future studies could pursue larger samples than our current one which spreads across four waves, thereby allowing fixed effects approaches to better control for individual differences over time.

Future research could also revisit the role of middle manager's agency (see e.g., Hallier and James, 1997) preceding formal- and substantive-rational task automation. For example, some middle managers may act as 'automation agents', who operate under the mandate to introduce digital alternations in their task context, and directly impact their role in strategy involvement. These are likely to be powerful middle managers who directly influence senior-executive managerial ranks (Heyden et al., 2017) and may possess substantial expertise in the area of automation technology. While the role of middle manager power is beyond the scope of our study, future research could examine how powerful actors in the firm's middle rank influence automation decisions more than others, and how this – in turn – affects the impact of formal-rational and substantive-rational task automation on their strategy involvement. Advancing toward this direction, future research can further contribute to our knowledge on how different forms of automation influence some middle managers differently than others – depending on their power to autonomously affect organizational processes.

It is also worth to note that the intention of automation from senior executive managerial ranks may affect middle managers role transitions in the organization (Autor, 2015). For example, in some cases, top managers may introduce automation systems with the purpose to facilitate middle managers' strategic involvement. In other cases, however, top managers may introduce digital technology to concentrate decision making power in the hands of the core group of senior decision makers by boldly diminishing the importance of the middle-rank. This latter aspect may be unlikely, given that the organization's internal talent pool to fill executive positions rests at the middle rank (Wooldridge et al., 2008; but see: Govindarajan et al., 2021). In fact, this aspect has been regarded by prior studies as an important factor that explains why the human actor continues to play a critical role in managerial positions – as organizations continue to groom leaders who are ready to undertake key leadership posts in the firm (Acemoglu and Restrepo, 2018a). In addition, top managers may decide to automate with the purpose to adopt to the various internal and external trends and demands surrounding the firm (e.g., through isomorphic tendencies), without directly considering the potential effects of automation on middle managers' strategic involvement. While the quantitative nature of our study does not allow us to observe in-depth the underlying reasons of automation, we consider such endogenous aspects empirically. Yet, future work can adopt qualitative or mixed-method research designs (see e.g., Ates et al., 2020) or experiments, to shed light on these micro-level processes that drive digital automation decisions.

## CONCLUSION

Our study adds to the continuing dialogue on the shifting roles of middle managers as automation technology is implemented in contemporary organizations. We have shown that middle managers' strategy involvement emerges from the co-production of automation in different management tasks in interaction with middle managers' individual level traits. This provides a nuanced picture of the impact of automation on the middle-management cadre – by offering evidence from a function (i.e., heads of controlling) that engages with both formal- and substantive-rational tasks (Weber, 2011). As automation technology penetrates the global economy, understanding the roles that middle

managers will play post-automation is expected to become of increasing importance, for both scholars and practitioners, in the years to come.

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## NOTES

- [1] As a robustness check, we run our analysis with also small firms (50 employees or less) included. Results of this analysis support the robustness of our findings. Yet, since the role of middle managers is likely to be very different in small organizations (with 50 or less employees) our analysis excludes these firms.

## REFERENCES

- Acemoglu, D. and Restrepo, P. (2018a). 'The race between man and machine: implications of technology for growth, factor shares, and employment'. *The American Economic Review*, **108**, 1488–542.
- Acemoglu, D. and Restrepo, P. (2018b). 'Low-skill and high-skill automation'. *Journal of Human Capital*, **12**, 204–32.
- Acemoglu, D. and Restrepo, P. (2019). 'Automation and new tasks: how technology displaces and reinstates labor'. *Journal of Economic Perspectives*, **33**, 3–30.
- Acemoglu, D. and Restrepo, P. (2020). 'Robots and jobs: evidence from US labor markets'. *Journal of Political Economy*, **128**, 2188–244.
- Allen, K. (2004). *Max Weber: A Critical Introduction*. London: Pluto Press.
- Antonakis, J., Bendahan, S., Jacquart, P. and Lalive, R. (2010). 'On making causal claims: a review and recommendations'. *The Leadership Quarterly*, **21**, 1086–120.
- Armstrong, J. S. and Overton, T. S. (1977). 'Estimating nonresponse bias in mail surveys'. *Journal of Marketing Research*, **14**, 396–402.
- Ashforth, B. E. and Saks, A. M. (1995). 'Work-role transitions: a longitudinal examination of the Nicholson model'. *Journal of Occupational and Organizational Psychology*, **68**, 157–75.
- Ates, N. Y., Tarakci, M., Porck, J. P., van Knippenberg, D. and Groenen, P. J. (2020). 'The dark side of visionary leadership in strategy implementation: strategic alignment, strategic consensus, and commitment'. *Journal of Management*, **46**, 637–65.
- Autor, D. H. (2015). 'Why are there still so many jobs? The history and future of workplace automation'. *Journal of Economic Perspectives*, **29**, 3–30.
- Balogun, J. and Johnson, G. (2004). 'Organizational restructuring and middle manager sensemaking'. *Academy of Management Journal*, **47**, 523–49.
- Becker, K. L. (2005). 'Individual and organisational unlearning: directions for future research'. *International Journal of Organisational Behaviour*, **9**, 659–70.
- Becker, S. D., Mahlendorf, M. D., Schaeffer, U. and Thaten, M. (2016). 'Budgeting in times of economic crisis'. *Contemporary Accounting Research*, **33**, 1489–517.
- Becker, T. E., Robertson, M. M. and Vandenberg, R. J. (2019). 'Nonlinear transformations in organizational research: possible problems and potential solutions'. *Organizational Research Methods*, **22**, 831–66.
- Benders, J., Batenburg, R. and Van der Blonk, H. (2006). 'Sticking to standards; technical and other isomorphic pressures in deploying ERP-systems'. *Information & Management*, **43**, 194–203.

- Benedikt F. C. and Osborne, M. A. (2017). 'The future of employment: how susceptible are jobs to computerisation?'. *Technological Forecasting and Social Change*, **114**, 254–80.
- Bhimani, A., Sivabalan, P. and Soonawalla, K. (2018). 'A study of the linkages between rolling budget forms, uncertainty and strategy'. *The British Accounting Review*, **50**, 306–23.
- Bhimani, A. and Willcocks, L. (2014). 'Digitisation, "Big Data" and the transformation of accounting information'. *Accounting and Business Research*, **44**, 469–90.
- Biddle, B. J. (1986). 'Recent developments in role theory'. *Annual Review of Sociology*, **12**, 67–92.
- Bloom, N., Garicano, L., Sadun, R. and Van Reenen, J. (2014). 'The distinct effects of information technology and communication technology on firm organization'. *Management Science*, **60**, 2859–85.
- Boone, C. and Hendriks, W. (2009). 'Top management team diversity and firm performance: moderators of functional-background and locus-of-control diversity'. *Management Science*, **55**, 165–80.
- Brennecke, J., Sofka, W., Wang, P. and Rank, O. N. (2021). 'How the organizational design of R&D units affects individual search intensity – a network study'. *Research Policy*, **50**, 104219.
- Brink, A. G., Coats, J. C. and Rankin, F. W. (2018). 'Who's the boss? The economic and behavioral implications of various characterizations of the superior in participative budgeting research'. *Journal of Accounting Literature*, **41**, 89–105.
- Broadbent, J. and Laughlin, R. (2009). 'Performance management systems: a conceptual model'. *Management Accounting Research*, **20**, 283–95.
- Bryant, M. and Stensaker, I. (2011). 'The competing roles of middle management: negotiated order in the context of change'. *Journal of Change Management*, **11**, 353–73.
- Brynjolfsson, E. and McAfee, A. (2014). *The Second Machine Age: Progress, and Prosperity in a Time of Brilliant Technologies*. New York: W.W. Norton & Company.
- Cadez, S. and Guilding, C. (2008). 'An exploratory investigation of an integrated contingency model of strategic management accounting'. *Accounting, Organizations and Society*, **33**, 836–63.
- Cannella Jr, A. A. and Georgakakis, D. (2017). 'Decision diversion: the roles of leadership context and other contingencies'. *Academy of Management Discoveries*, **3**, 428–30.
- Cannella Jr, A. A., Park, J. H. and Lee, H. U. (2008). 'Top management team functional background diversity and firm performance: examining the roles of team member colocation and environmental uncertainty'. *Academy of Management Journal*, **51**, 768–84.
- Carter, M. J. and Fuller, C. (2016). 'Symbols, meaning, and action: the past, present, and future of symbolic interactionism'. *Current Sociology*, **64**, 931–61.
- Chong, V. K. and Wang, I. Z. (2019). 'Delegation of decision rights and misreporting: the roles of incentive-based compensation schemes and responsibility rationalization'. *European Accounting Review*, **28**, 275–307.
- Claussen, J., Grohsjean, T., Luger, J. and Probst, G. (2014). 'Talent management and career development: what it takes to get promoted'. *Journal of World Business*, **49**, 236–44.
- Clinton, B. D. and White, L. R. (2012). 'The role of the management accountant: 2003–2012'. *Management Accounting Quarterly*, **14**, 40–74.
- Cooper, L. A., Holderness Jr, D. K., Sorensen, T. L. and Wood, D. A. (2019). 'Robotic process automation in public accounting'. *Accounting Horizons*, **33**, 15–35.
- Currie, G. and Procter, S. J. (2005). 'The antecedents of middle managers' strategic contribution: the case of a professional bureaucracy'. *Journal of Management Studies*, **42**, 1325–56.
- Dane, E. (2010). 'Reconsidering the trade-off between expertise and flexibility: a cognitive entrenchment perspective'. *Academy of Management Review*, **35**, 579–603.
- Delmestri, G. and Walgenbach, P. (2005). 'Mastering techniques or brokering knowledge? Middle managers in Germany, Great Britain and Italy'. *Organization Studies*, **26**, 197–220.
- Dutton, J. E. and Ashford, S. J. (1993). 'Selling issues to top management'. *Academy of Management Review*, **18**, 397–428.
- Endsley, M. R. and Kiris, E. O. (1995). 'The out-of-the-loop performance problem and level of control in automation'. *Human Factors*, **37**, 381–94.
- EU Commission (2019). *SME Definition*. Available at: [https://ec.europa.eu/growth/smes/sme-definition\\_en](https://ec.europa.eu/growth/smes/sme-definition_en) (accessed 14 September 2020).
- Ferguson, J. P. and Hasan, S. (2013). 'Specialization and career dynamics: evidence from the indian administrative service'. *Administrative Science Quarterly*, **58**, 233–56.
- Firk, S., Hanelt, A., Oehmichen, J. and Wolff, M. (2021). 'Chief digital officers: an analysis of the presence of a centralized digital transformation role'. *Journal of Management Studies*, **58**, 1800–31.
- Floyd, S. W. and Lane, P. J. (2000). 'Strategizing throughout the organization: managing role conflict in strategic renewal'. *Academy of Management Review*, **25**, 154–77.

- Floyd, S. W. and Wooldridge, B. (1992). 'Middle management involvement in strategy and its association with strategic type: a research note'. *Strategic Management Journal*, **13**, 153–67.
- Føllesdal, D. 1994. 'The status of rationality assumptions in interpretation and in the explanation of action'. In M. Martin and L. C. McIntyre (Eds), *Readings in the Philosophy of Social Science*. Cambridge, MA: MIT Press, 299–310.
- Fondas, N. and Stewart, R. (1994). 'Enactment in managerial jobs: a role analysis'. *Journal of Management Studies*, **31**, 83–103.
- Georgakakis, D. and Buyl, T. (2020). 'Guardians of the previous regime: post-CEO succession factional subgroups and firm performance'. *Long Range Planning*, **53**, 101971.
- Georgakakis, D., Greve, P. and Ruigrok, W. (2018). 'Differences that matter: hiring modes and demographic (dis)similarity in executive selection'. *The International Journal of Human Resource Management*, **32**, 650–79.
- Georgakakis, D., Heyden, M. L., Oehmichen, J. D. and Ekanayake, U. I. (2022). 'Four decades of CEO–TMT interface research: a review inspired by role theory'. *The Leadership Quarterly*, **33**, 101354.
- Georgakakis, D. and Ruigrok, W. (2017). 'CEO succession origin and firm performance: a multilevel study'. *Journal of Management Studies*, **54**, 58–87.
- Gibbert, M., Ruigrok, W. and Wicki, B. (2008). 'What passes as a rigorous case study?'. *Strategic Management Journal*, **29**, 1465–74.
- Govindarajan, V., Sikka, N. and Srivastava, A. (2021). 'The uncertainty of middle management jobs – and how to stay relevant'. *California Management Review*. Available at: <https://cmr.berkeley.edu/2021/01/middle-management-jobs/> (accessed 20 April 2022).
- Gupta, P. P. and Thomson, J. C. (2006). 'Management reporting on internal control'. *Strategic Finance*, **88**, 27–33.
- Haefner, N., Wincent, J., Parida, V. and Gassmann, O. (2021). 'Artificial intelligence and innovation management: a review, framework, and research agenda'. *Technological Forecasting and Social Change*, **162**, 120392.
- Hallier, J. and James, P. (1997). 'Middle managers and the employee psychological contract: agency, protection and advancement'. *Journal of Management Studies*, **34**, 703–28.
- Hambrick, D. C. and Fukutomi, G. D. (1991). 'The seasons of a CEO's tenure'. *Academy of Management Review*, **16**, 719–42.
- Hamori, M. and Koyuncu, B. (2015). 'Experience matters? The impact of prior CEO experience on firm performance'. *Human Resource Management*, **54**, 23–44.
- Hanelt, A., Bohnsack, R., Marz, D. and Antunes Marante, C. (2021). 'A systematic review of the literature on digital transformation: insights and implications for strategy and organizational change'. *Journal of Management Studies*, **58**, 1159–97.
- Harris, D. and Helfat, C. (1997). 'Specificity of CEO human capital and compensation'. *Strategic Management Journal*, **18**, 895–920.
- Harrison, J. S., Thurgood, G. R., Boivie, S. and Pfarrer, M. D. (2019). 'Measuring CEO personality: developing, validating, and testing a linguistic tool'. *Strategic Management Journal*, **40**, 1316–30.
- Herrmann, P. and Datta, D. K. (2006). 'CEO experiences: effects on the choice of FDI entry mode'. *Journal of Management Studies*, **43**, 755–78.
- Heyden, M. L. M., Fourné, S. P. L., Koene, B. A. S., Werkman, R. and Ansari, S. S. (2017). 'Rethinking "top-down" and "bottom-up" roles of top and middle managers in organizational change: implications for employee support'. *Journal of Management Studies*, **54**, 961–85.
- Heyden, M. L., Sidhu, J. S. and Volberda, H. W. (2018). 'The conjoint influence of top and middle management characteristics on management innovation'. *Journal of Management*, **44**, 1505–29.
- Heyden, M. L., Wilden, R. and Wise, C. (2020). 'Navigating crisis from the backseat? How top managers can support radical change initiatives by middle managers'. *Industrial Marketing Management*, **88**, 305–13.
- Huy, Q. N. (2002). 'Emotional balancing of organizational continuity and radical change: the contribution of middle managers'. *Administrative Science Quarterly*, **47**, 31–69.
- Ibarra, H. and Barbulescu, R. (2010). 'Identity as narrative: prevalence, effectiveness, and consequences of narrative identity work in macro work role transitions'. *Academy of Management Review*, **35**, 135–54.
- Kalogeraki, O. and Georgakakis, D. (2022). 'Friend or Foe? CEO gender, political ideology, and gender-pay disparities in executive compensation'. *Long Range Planning*, **55**, 102126.
- Kane, G. C., Palmer, D., Philips, A. N., Kiron, D. and Buckley, N. (2016). 'Aligning the Organization For its Digital Future'. *MIT Sloan Management Review and Deloitte University Press*, **58**.
- Kanellou, A. and Spathis, C. (2013). 'Accounting benefits and satisfaction in an ERP environment'. *International Journal of Accounting Information Systems*, **14**, 209–34.

- Karaevli, A. and Hall, D. T. T. (2006). 'How career variety promotes the adaptability of managers: a theoretical model'. *Journal of Vocational Behavior*, **69**, 359–73.
- Karaevli, A. and Zajac, E. J. (2013). 'When do outsider CEOs generate strategic change? The enabling role of corporate stability'. *Journal of Management Studies*, **50**, 1267–94.
- Knight, W. (2017). 'The dark secret at the heart of AI'. *Technology Review*, **120**, 54–61.
- Kondrat, M. E. (1992). 'Reclaiming the practical: formal and substantive rationality in social work practice'. *Social Service Review*, **66**, 237–55.
- Kremser, W. and Blagoev, B. (2021). 'The dynamics of prioritizing: how actors temporally pattern complex role–routine ecologies'. *Administrative Science Quarterly*, **66**, 339–79.
- von Krogh, G. (2018). 'Artificial intelligence in organizations: new opportunities for phenomenon-based theorizing'. *Academy of Management Discoveries*, **4**, 404–09.
- Krzywdzinski, M. (2021). 'Automation, digitalization, and changes in occupational structures in the automobile industry in Germany, Japan, and the United States: a brief history from the early 1990s until 2018'. *Industrial and Corporate Change*, **30**, 499–535.
- Kunze, F., Boehm, S. A. and Bruch, H. (2011). 'Age diversity, age discrimination climate and performance consequences – a cross organizational study'. *Journal of Organizational Behavior*, **32**, 264–90.
- Lindebaum, D., Vesa, M. and den Hond, F. (2020). 'Insights from “the machine stops” to better understand rational assumptions in algorithmic decision making and its implications for organizations'. *Academy of Management Review*, **45**, 247–63.
- Lindell, M. K. and Whitney, D. J. (2001). 'Accounting for common method variance in cross-sectional research designs'. *Journal of Applied Psychology*, **86**, 114–21.
- Loebbecke, C. and Picot, A. (2015). 'Reflections on societal and business model transformation arising from digitization and big data analytics: a research agenda'. *Journal of Strategic Information Systems*, **24**, 149–57.
- Lubatkin, M. H., Simsek, Z., Ling, Y. and Veiga, J. F. (2006). 'Ambidexterity and performance in small-to medium-sized firms: the pivotal role of top management team behavioral integration'. *Journal of Management*, **32**, 646–72.
- Malhotra, N. K., Kim, S. S. and Patil, A. (2006). 'Common method variance in IS research: a comparison of alternative approaches and a reanalysis of past research'. *Management Science*, **52**, 1865–83.
- Mangaliso, M. P. (1995). 'The strategic usefulness of management information as perceived by middle managers'. *Journal of Management*, **21**, 231–50.
- Mantere, S. (2008). 'Role expectations and middle manager strategic agency'. *Journal of Management Studies*, **45**, 294–316.
- McArdle, J. J. (2009). 'Latent variable modeling of differences and changes with longitudinal data'. *Annual Review of Psychology*, **60**, 577–605.
- Mellahi, K. and Harris, L. C. (2016). 'Response rates in business and management research: an overview of current practice and suggestions for future direction'. *British Journal of Management*, **27**, 426–37.
- Merchand, K. and Van der Stede, D. S. W. (2017). *Management Control Systems*, 4th ed. Harlow: Pearson.
- Millman, Z. and Hartwick, J. (1987). 'The impact of automated office systems on middle managers and their work'. *MIS Quarterly*, **11**, 479–91.
- Moeller, K., Schaeffer, U. and Verbeeten, F. (2020). 'Digitalization in management accounting and control: an editorial'. *Journal of Management Control*, **31**, 1–8.
- Moll, J. and Yigitbasoglu, O. (2019). 'The role of internet-related technologies in shaping the work of accountants: new directions for accounting research'. *The British Accounting Review*, **51**, 100833.
- Morrison, R. F. and Brantner, T. M. (1992). 'What enhances or inhibits learning a new job? A basic career issue'. *Journal of Applied Psychology*, **77**, 926–40.
- Mueller, P. E., Georgakakis, D., Greve, P., Peck, S. and Ruigrok, W. (2021). 'The curse of extremes: generalist career experience and CEO initial compensation'. *Journal of Management*, **47**, 1977–2007.
- Neter, J., Wasserman, W. and Kutner, M. H. (1990). *Applied Statistical Models*. Burr Ridge, IL: Richard D. Irwin, Inc.
- Ng, T. W. and Feldman, D. C. (2013). 'Does longer job tenure help or hinder job performance?'. *Journal of Vocational Behavior*, **83**, 305–14.
- Nicholson, N. (1984). 'A theory of work role transitions'. *Administrative Science Quarterly*, **29**, 172–91.
- Oesterreich, T. D., Teuteberg, F., Bensberg, F. and Buscher, G. (2019). 'The controlling profession in the digital age: understanding the impact of digitisation on the controller's job roles, skills and competences'. *International Journal of Accounting Information Systems*, **35**, 100432.
- Ou, A. Y., Seo, J. J., Choi, D. and Hom, P. W. (2017). 'When can humble top executives retain middle managers? The moderating role of top management team faultlines'. *Academy of Management Journal*, **60**, 1915–31.

- Pinsonneault, A. and Kraemer, K. L. (1993). 'The impact of information technology on middle managers'. *MIS Quarterly*, **17**, 271–92.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y. and Podsakoff, N. P. (2003). 'Common method biases in behavioral research: a critical review of the literature and recommended remedies'. *Journal of Applied Psychology*, **88**, 879–903.
- Posner, B. (2018). 'Is the threat of digital disruption overhyped?'. *MIT Sloan Management Review*, **59**, 96.
- Raes, A., Heijltjes, M., Glunk, U. and Roe, R. A. (2011). 'The interface of the top management team and middle managers: a process model'. *Academy of Management Review*, **36**, 102–26.
- Raisch, S. and Krakowski, S. (2021). 'Artificial intelligence and management: the automation–augmentation paradox'. *Academy of Management Review*, **46**, 192–210.
- Rangarajan, D., Jones, E. and Chin, W. (2005). 'Impact of sales force automation on technology-related stress, effort, and technology usage among salespeople'. *Industrial Marketing Management*, **34**, 345–54.
- Reimer, M., Van Doorn, S. and Heyden, M. L. (2016a). "Where the rubber hits the road": a panel discussion on management control systems at the middle management level'. *Journal of Management Control*, **27**, 281–87.
- Reimer, M., Van Doorn, S. and Heyden, M. L. (2016b). 'Managers and management control systems in the strategy process'. *Journal of Management Control*, **27**, 121–127.
- Richins, G., Stapleton, A., Stratopoulos, T. C. and Wong, C. (2017). 'Big data analytics: opportunity or threat for the accounting profession?'. *Journal of Information Systems*, **31**, 63–79.
- Rouleau, L. and Balogun, J. (2011). 'Middle managers, strategic sensemaking, and discursive competence'. *Journal of Management Studies*, **48**, 953–983.
- Russell, C. J. and Dean, M. A. (2000). 'To log or not to log: bootstrap as an alternative to the parametric estimation of moderation effects in the presence of skewed dependent variables'. *Organizational Research Methods*, **3**, 166–85.
- Schwab, K. and Davis, N. (2018). *Shaping the Future of the Fourth Industrial Revolution*. London: Portfolio Penguin.
- Sengupta, K., T. K. Abdel-Hamid and Van Wassenhove L. N. (2008). 'The experience trap', *Harvard Business Review*, **86**, 94–101.
- Semadeni, M., Withers, M. C. and Certo, T. S. (2014). 'The perils of endogeneity and instrumental variables in strategy research: understanding through simulations'. *Strategic Management Journal*, **35**, 1070–79.
- Shortell, S. M. and Zajac, E. J. (1990). 'Perceptual and archival measures of miles and snow's strategic types: a comprehensive assessment of reliability and validity'. *Academy of Management Journal*, **33**, 817–33.
- Sieber, S. D. (1974). 'Toward a theory of role accumulation'. *American Sociological Review*, **39**, 567–78.
- Singh, A. and Hess, T. (2017). 'How chief digital officers promote the digital transformation of their companies'. *MIS Quarterly Executive*, **16**, 1–17.
- Solarino, A. M. and Aguinis, H. (2021). 'Challenges and best-practice recommendations for designing and conducting interviews with elite informants'. *Journal of Management Studies*, **58**, 649–72.
- Stubbings, C., Homer, D. and Francis, J. (2019). 'Thawing the frozen middle'. Strategy+Business. Available at: <https://www.strategy-business.com/article/Thawing-the-frozen-middle> (accessed 26 November 2019).
- Tuggle, C. S., Sirmon, D. G., Borgholthaus, C. J., Bierman, L. and Bass, A. E. (2022). 'From seats at the table to voices in the discussion: antecedents of underrepresented director participation in board meetings'. *Journal of Management Studies*, **59**, 1253–83.
- Van Doorn, S., Heyden, M., Tröster, C. and Volberda, H. (2015). 'Entrepreneurial orientation and performance: investigating local requirements for entrepreneurial decision-making'. In *Cognition and Strategy*. Bingley: Emerald Group Publishing Limited.
- Van Doorn, S., Heyden, M. L. M. and Volberda, H. W. (2017). 'Enhancing entrepreneurial orientation in dynamic environments: the interplay between top management team advice-seeking and absorptive capacity'. *Long Range Planning*, **50**, 134–44.
- Van Doorn, S., Heyden, M. L., Reimer, M., Buyl, T. and Volberda, H. W. (2022). 'Internal and external interfaces of the executive suite: advancing research on the porous bounds of strategic leadership'. *Long Range Planning*, **55**, 102214.
- Warren Jr, J. D., Moffitt, K. C. and Byrnes, P. (2015). 'How big data Will change accounting'. *Accounting Horizons*, **29**, 397–407.
- Weber, J. (2011). 'The development of controller tasks: explaining the nature of controllership and its changes'. *Journal of Management Control*, **22**, 25–46.
- Wesche, J. S. and Sonderegger, A. (2019). 'When computers take the lead: the automation of leadership'. *Computers in Human Behavior*, **101**, 197–209.

- Wijethilake, C., Munir, R. and Appuhami, R. (2018). 'Environmental innovation strategy and organizational performance: enabling and controlling uses of management control systems'. *Journal of Business Ethics*, **151**, 1139–60.
- Wooldridge, B., Schmid, T. and Floyd, S. W. (2008). 'The middle management perspective on strategy process: contributions, synthesis, and future research'. *Journal of Management*, **34**, 1190–221.
- Wooldridge, B. and Floyd, S. W. (1990). 'The strategy process, middle management involvement, and organizational performance'. *Strategic Management Journal*, **11**, 231–41.

## APPENDIX 1

### QUALITATIVE INSIGHTS FROM QUALITATIVE INTERVIEWS WITH MIDDLE MANAGEMENT HEADS OF CONTROLLING

	<i>Relevant insights and observations</i>	<i>Exemplary quotes from interviewees</i>	<i>Interpretation and links to our theorizing</i>
The nature of reporting as a formal-rational task	For reporting, all respondents were clear that it represents a task where large quantities of 'explicit' information are collected, edited, and shared.	<ul style="list-style-type: none"> <li>• 'Reporting is a routine activity that considers the current situation of the firm'.</li> <li>• 'Reporting automation allows us to capture retrospective processes more efficiently'.</li> </ul>	<ul style="list-style-type: none"> <li>• The observed quotes align with the definition that reporting is a formal-rational task, routine-based in nature, and is based on explicit knowledge that are more easily replaced by automaton.</li> <li>• The second quote confirms our assumption that formal-rational automation associates with time efficiencies post-automation.</li> <li>• Interpreting this in parallel with our quantitative insights, such time efficiencies may – ceteris paribus – offer opportunities to middle managers for realizing role accumulation to enhance their strategic impact.</li> </ul>
The nature of budgeting as a substantive-rational task	For budgeting respondents emphasized the discontinuous character of budgeting activities and underlined the importance of flexibility when executing this task.	<ul style="list-style-type: none"> <li>• 'Budgeting and investment decisions depend on many different facets that vary over time'.</li> <li>• When reflecting on budgeting; 'The automated tools are reaching their limits due to the lack of built-in flexibility'.</li> </ul>	<ul style="list-style-type: none"> <li>• The observed quotes about budgeting confirm the definition that budgeting is a substantive rational task that is complex and multifaceted in nature.</li> <li>• The substantive rational tasks are more difficult to automate, and automation output require extra effort from the human actor to overcome system inflexibility.</li> <li>• Interpreting this in parallel with our quantitative insights, this extra effort may – ceteris paribus – reduce middle managers' focus on realizing opportunities for role accumulation and strategy involvement post automation.</li> </ul>

	<i>Relevant insights and observations</i>	<i>Exemplary quotes from interviewees</i>	<i>Interpretation and links to our theorizing</i>
Human-system interface when formal rational tasks are automated	For reporting automation, middle managers generally acknowledge that their roles are more replaced by the system, demanding less human-system interaction post-automation. In addition, we observe that, for some middle managers, this leads to stress and concerns that some of their roles may be enveloped. Others, meanwhile, underscore efficiency gains.	<ul style="list-style-type: none"> <li>• Because reporting follows ‘<i>established rules you can automate this task more easily and completely</i>’.</li> <li>• ‘<i>Reporting is now carried out in a largely autonomous manner by the system and I fear that our role may be displaced</i>’.</li> </ul>	<ul style="list-style-type: none"> <li>• The first and second quotes confirm our assumption that reporting automation replaces the human actor, demanding less human-system interaction post-automation</li> <li>• The second quote also demonstrates that formal rational task automation may, for some middle managers, generate cognitive displacement and fear that their well-learned routine role will be enveloped post-automation.</li> <li>• This, in parallel with our quantitative insights, confirm that some middle managers may be more able to benefit from formal rational task automation than others.</li> </ul>
Human-system interface when substantive rational tasks are automated	For budgeting automation, middle managers generally acknowledge that the complex nature of the budgeting task complicates automation, and may generate inefficiencies at the human system interface post-automation. This, for some middle managers, generates a preoccupation with filling gaps left by the automated system.	<ul style="list-style-type: none"> <li>• ‘<i>Budgeting automation is often unable to account for ad-hoc target adjustments</i>’, [... and...], ‘<i>budget automation does not work when it concerns new market development, where data is scarce and the gut feeling is important</i>’.</li> <li>• <i>With budgeting automation, ‘I sometimes have my doubts that all relevant information is accounted for in each decision’.</i></li> </ul>	<ul style="list-style-type: none"> <li>• The first quote confirms the limits of ‘budgeting automation, and the need for human system interaction post-automation (i.e., human gut feeling and expertise-based intuition).</li> <li>• The second quote confirms our logic that budgeting automation can generate inefficiencies at the human-system interface and more monitoring.</li> <li>• In parallel with our quantitative insights, this may generate a preoccupation with filling gaps left by the automated system to middle managers, and reduce exploration of role accumulation for enhancing their strategy involvement.</li> </ul>